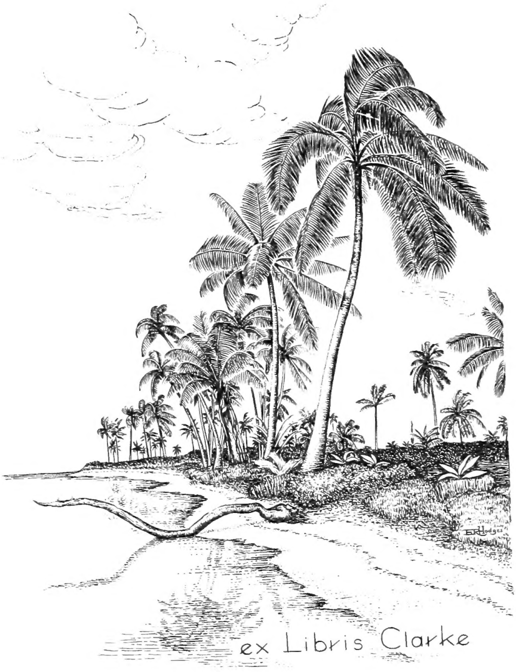
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31 March 1965

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LARVAL FOOD PLANTS AND DISTRIBUTION NOTES FOR TWENTY-FOUR TEXAS HESPERIIDAE

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This is the fifth in a series of papers recording larval food plants for Texan butterflies and skippers. In this paper, 62 plant species representing 8 families are given for the following 24 hesperiids. Arrangement for the skippers follows dos Passos (1964):

Hesperiinae

Calpodes ethlius (Stoll), *Amblyscirtes vialis* (Edwards), *Polites vibex praeceps* (Scudder), *Hesperia viridis* (Edwards), *Copæodes aurantiaca* (Hewitson).

Pyrginae

Pholisora catullus (Fabricius), *Celotes nessus* (Edwards), *Heliopetes laviana* (Hewitson), *Heliopetes macaira* (Reakirt), *Pyrgus communis communis* (Grote), *Erynnis baptisiæ* (Forbes), *Erynnis horatius* (Scudder & Burgess), *Gesta gesta invisus* (Butler & Druce), *Achlyodes thraso tamenund* (Edwards), *Systasea pulverulenta* (R. Felder), *Staphylus mazans mazans* (Reakirt), *Cogia hippalus outis* (Skinner), *Thorybes bathyllus* (Smith), *Thorybes pylades* (Scudder) and "form" *albosuffusa* H. A. Freeman, *Achalarus lyciades* (Geyer), *Achalarus toxeus* (Plötz), *Urbanus proteus* (Linnaeus), *Chioides catillus albofasciatus* (Hewitson), *Epargyreus clarus clarus* (Cramer).

Each of these species is treated separately in the order given. Also, a chart of larval food plants, arranged alphabetically by plant family and genus, summrizes these data.

[1] Acknowledgment is made to the Rob and Bessie Welder Wildlife Foundation for providing a portion of the publication costs.

Calpodes ethlius (Stoll). The brazilian skipper is probably more common and widespread in Texas than present records indicate. It seems to be closely associated with its larval food plants, cannas. In the lower Rio Grande Valley, Freeman (1951) has collected *C. ethlius* from April to December. In more northern parts of its range, the flight period is from March to October, indicating a more prolonged larval or pupal diapause.

The present known distribution of this skipper in Texas is limited to eight counties: Bexar, May–Oct.; Cameron, Apr.–Dec.; Dallas, June–Oct.; Fayette, May; Hidalgo, Apr.–Dec.; San Patricio, Oct.–Nov.; Tarrant, Sept.; and Travis, Sept. The writer has reared larvae through which were collected on *Canna indica* L., but the food plant has never been grown in the laboratory garden; therefore, a careful study of its life history has not been made.

Bexar Co.: 16 June 1956. Six larvae, collected on *C. indica*, pupated from 28 June to 11 July. Adults emerged from 6 to 18 July.

Fayette Co.: 26 May 1956. At a cafe in Schulenburg where cannas were grown as ornamentals, numerous larvae were present in their rolled leaf nests.

Tarrant Co.: 22 September 1962. Attention was called to numerous larvae on cannas growing in a yard in Fort Worth. One pupa, in its rolled leaf shelter, was taken. A male emerged 23 September.

Amblyscirtes vialis (Edwards). The roadside skipper's distribution in Texas is not well defined. It appears to be more or less confined to the north-central and northeastern portions of the State. The species has been collected from the first week in April to June. Additional rearing is necessary to determine the number of broods in Texas.

Brown Co.: 9 April 1964. At Lake Brownwood State Park, a female was collected and kept for eggs. It was confined with *Stenotaphrum secundatum* (Walt.) Kuntze and *Cynodon dactylon* (L.) Pers. More than 50 eggs were deposited by 20 April when the female died. Eggs were deposited on both grasses; they started hatching 18 April. Newly hatched larvae were offered *S. secundatum* which they sampled but then refused, and many died. They were then offered *C. dactylon* on which they matured. Pupation occurred: 18 May (2), 19 May (2), 20 May (5), 21 May (2), 22 May (1), 23 May (1), 24 May (1), 26 May (1), 27 May (1), and 30 May (1). Six ♂♂ and 5♀♀, emerged: 27 May (1♂, 1♀), 29 May (2♂♂), 31 May (1♂, 2♀♀), 4 June (1♀), 5 June (1♂), and 9 June (1♂).

When fully mature, larvae seek the ground to pupate. Larvae cut circular disks from a paper table napkin on the bottom of the container, and fashioned nests in which to pupate. Immature stages were preserved and live pupae furnished Dr. C. L. Remington for chromosome studies.

Five other Texas counties in which the writer collected *A. vialis* in 1964 are: Cherokee, 4 Apr.; Harrison, 5 & 6 Apr., eggs obtained from one female but all first instar larvae perished on *S. secundatum*; Smith, 4 Apr.; Tarrant, 8 & 9 Apr.; Titus, 6 Apr.

Polites vibex præceps (Scudder). The whirlabout has been recorded

as a constant flyer in extreme southern Texas by Freeman (1951). While an occasional specimen may be collected throughout the year in certain localities, its principal flight is from April to October. During this period considerable overlapping of broods occurs. *P. præceps* is well adapted to metropolitan living where it oviposits on bermuda, *Cynodon dactylon* Pers.; St. Augustine, *Stenotaphrum secundatum* Kuntze; and doubtless other local grasses. Additional fieldwork is necessary to establish its exact range over the State and the blend zone with *Polites vibex brettoides* (Edwards). It would seem to have a larval or pupal diapause; additional rearing will determine this.

Bexar Co.: 30 July 1963. A female was collected in the laboratory garden in San Antonio, where the species is well established, and kept for eggs. During the next five days, 90 eggs were deposited on S. *secundatum*, after which the female was released. Eggs started hatching 3 August. Larvae were reared through on S. *secundatum*, pupating: 1 Sept. (1), 6 Sept. (5), 7 Sept. (12), 9 Sept. (10), 12 Sept. (1), and 14 Sept. (4). Fifteen ♂♂ and 13♀♀ emerged: 11 Sept. (1♂), 15 Sept. (3♂♂, 1♀), 16 Sept. (4♂♂, 5♀♀), 17 Sept. (4♂♂, 2♀♀), 18 Sept. (1♂, 2♀♀), 20 Sept. (1♂, 1♀), 22 Sept. (1♂), 23 Sept. (1♀), and 25 Sept. (1♀). Immatures were preserved. At a sidewalk cafe in San Antonio, on 30 Sept. 1963 a female was observed to deposit 15 ova in about 10 minutes, one at a time, on *C. dactylon*.

Cameron Co.: 18 October 1963. At Brownsville, a female was collected and kept alive for eggs. It received only modest care in the improvised field laboratory, and after depositing five eggs it perished. Eggs hatched 26 October. Two first instar larvae were accidentally lost. The remaining three, reared through on S. *secundatum*, pupated 14 & 17 December and 8 January. Adults, emerged: 8 Jan. (1♀), 11 Jan. (1♀), and 31 Jan. (1♀). A most interesting discovery was that these females did not have the usual blurred markings on the HW beneath; instead, the marks were sharp and well defined.

The writer has collected *P. præceps* in four other Texas counties: Comal, 27 July 1963; Hidalgo, 31 Mar. 1960, 17 Oct. 1963; Kimble, 20 July 1963; San Patricio, 14 & 15 Sept., 13 & 20 Oct. 1963; and Zavala, 18 Aug. 1963.

Hesperia viridis (Edwards). The green skipper's range in Texas appears to be from the Edwards Plateau northward. Too few records have been published for the State to give much of an idea as to its exact distribution. Present field data would indicate two distinct flights: April–June and August–October. Reared adults have emerged in January and February, but this may not occur in nature. There is some indication that *viridis* may feed all winter on a grass such as *Bouteloua gracilis* Lag. and pupate in spring, emerging in April or May, depending on climatic conditions. May is by far the best time to collect *viridis* in the southern part of its range.

Bexar Co.: 6 October 1963. Near the intersection of Babcock Road and F.M. 1604, NW of San Antonio, 13 adults were collected on wild flowers along the road. Two females collected 6 October were kept alive for eggs. They were caged over *Stenotaphrum secundatum* Kuntze. The following day several ova were deposited

on the grass and two on the container. By 8 October, 14 ova had been deposited, more than half of them on the container. One female died 8 Oct., the other was then offered *Cynodon dactylon* (L.) Pers. Eighteen eggs were deposited the following day, all on the grass. First instar larvae were offered *S. secundatum* which they accepted reluctantly. Numerous larvae died by mid-December. The survivors were then offered *C. dactylon*. Only two larvae died following the transfer. Still later, larvae were offered *Lolium perenne* L., which they accepted. Five larvae were reared through, pupating 1, 11, 21, & 28 January and 1 February 1964. Adults, emerged: 28 Jan. (1♂), 5 Feb. (1♀), 12 Feb. (1♂), 22 Feb. (1♀), and 28 Feb. (1♀).

This is believed to be the first Bexar County record for *H. viridis*. On 9 October, Roy W. Quillin collected one specimen at Helotes, a few miles west of this spot, and on 10 & 11 October, Dr. J. W. Tilden collected 35 specimens near the first mentioned spot.

The writer has collected *viridis* in only two other Texas counties: Blanco, 3 May 1963; Comal, 11 May 1958, 15 & 22 May 1960, and 21 May 1962. Freeman (1951) and MacNeill (1964) have recorded it from several other Texas counties.

Copæodes aurantiaca (Hewitson). The orange skipperling, common at times, may be found in all major botanical areas of Texas. It has been collected from February to November. *C. aurantiaca* is most often seen around patches of Bermuda grass, *Cynodon dactylon* Pers., its only known larval food plant. Since the food plant is a perennial, dying back with the first hard freeze, a pupal diapause is indicated.

Bexar Co.: 30 June 1956. A female collected in the laboratory garden at San Antonio deposited numerous eggs on *C. dactylon* the same day. Ova started hatching 4 July. Fifty-six larvae were inventoried 15 July. Larvae pupated: 19 July (8), 20 July (2), 21 July (2), 23 July (5), 24 July (3), 26 July (1), 28 July (8), 1 Aug. (5), 6 Aug. (1), and 7 Aug. (1). In addition to immatures which were preserved, 16♂♂ and 13♀♀ emerged: 24 July (1♂), 25 July (3♂♂), 26 July (2♂♂, 1♀), 27 July (2♂♂, 1♀), 28 July (1♂, 1♀), 29 July (1♂, 1♀), 30 July (2♂♂), 31 July (1♂, 1♀), 1 Aug. (1♂), 2 Aug. (2♀♀), 3 Aug. (2♀♀), 6 Aug. (1♀), 7 Aug. (2♂♂, 1♀), 8 Aug. (1♀), and 10 Aug. (1♀).

Another female, collected in the laboratory garden 13 September 1958, deposited a quantity of ova on *C. dactylon*. Eggs started hatching 18 September. The first larva pupated 11 October. Adults emerged in due course but emergence dates were not recorded.

Pholisora catullus (Fabricius). The common sooty-wing ranges over the entire state of Texas. In certain sections, it has been collected each month of the year. Its principal flight, however, is from March to November. During this time July and November are the least likely months to find it on the wing. This species has a larval diapause which results in adults mostly in March. Immatures have been collected in nature on *Amaranthus caudatus* L., *A. spinosus* L., *A. retroflexus* L., *Chenopodium album* L., *C. ambrosioides* L., and *C. berlandieri* Moq.

Bexar Co.: 27 August 1956. In a city alley near the laboratory, 13 larvae, two of which were parasitized, were found on *A. spinosus*. Larvae pupated from 26 Aug.

to 5 Sept. Six ♂♂ and 5♀♀, emerged: 2 Sept. (1♀), 4 Sept. (1♀), 5 Sept. (1♂), 6 Sept. (1♀), 7 Sept. (2♂♂), 8 Sept. (1♂, 1♀), 10 Sept. (1♀), and 11 Sept. (2♂♂). At another location just north of San Antonio, seven larvae were found 11 November 1956 on *A. retroflexus*. Three of these proved to be parasitized. Two larvae remained in diapause until 22 April 1957 after which they perished, probably due to dehydration. One male emerged 3 February and another male on 11 February 1957; pupation dates unobserved. In the laboratory garden 18 May 1958, numerous larvae were observed on *A. spinosus*. Several were collected and pupation occurred 25 May. Emergence dates were not recorded. A female taken 30 August 1958 deposited 23 eggs on *A. spinosus* under laboratory conditions; all ova were preserved.

A few miles south of San Antonio, a female was collected 23 April 1960 while flying around *C. album*. Examination of the plant disclosed one larva which later died of parasitism. The captive female deposited numerous ova on *C. album*, and these later hatched. Due to improper care, most of the larvae were lost to fungus. All other larvae and pupae were preserved.

North of San Antonio, 15 larvae were found 6 August 1960 on *C. album*. Five of these died from parasitism or other causes, the remainder pupated in due course with 6♂♂ and 4♀♀ emerging: 16 Aug. (2♂♂), 17 Aug. (1♀), 21 Aug. (1♀), 25 Aug. (1♀), 26 Aug. (3♂♂), 28 Aug. (1♀), and 29 Aug. (1♂). On 8 April 1961, four larvae were collected on *C. album* which pupated in due course. Adults, emerged: 29 Apr. (2♂♂), 11 May (1♀), and 27 May (1♀). On 5 October 1963, two females were observed to oviposit on *A. retroflexus*. They were not collected.

Cameron Co.: 21 April 1962. At the Laguna Atascosa National Wildlife Refuge, four larvae were collected on *C. ambrosioides*. Larvae matured in due course with adults emerging: 3 May (1♂, 1♀), 7 May (1♀), and 13 May (1♀). At another location in the county, about 16 miles SE of Brownsville, seven larvae were collected 19 October 1963 on *A. caudatus*. Three of these entered diaspause; the remaining four pupated in due course. One pupa died. Adults emerged: 6 Nov. (1♂), 7 Nov. (1♀), and 2 Dec. (1♂). The three larvae in diapause had not pupated 15 February 1964 when this paper was prepared.

Guadalupe Co.: 7 July 1962. At a roadside park on U. S. Highway 90, three miles E of Kingsbury, one larva was collected on *A. retroflexus* which produced a male 20 July.

Live Oak Co.: 10 September 1960. On Texas Highway 9 about eight miles NW of Mathis, one larva was found on *C. berlandieri* which produced a female 2 October.

San Patricio Co.: 21 August 1960. At Lake Corpus Christi State Park, one larva collected on *C. berlandieri* pupated 22 August and a male emerged 30 August. At the Welder Wildlife Refuge, one larva was found 5 July 1963 on *C. berlandieri*; it pupated 13 July and a male emerged 20 July. Again, near Mathis, one larva was collected 15 September 1963 on *A. hybridus*; it pupated 16 September and a female emerged 24 September.

Val Verde Co.: 1 May 1961. At Lake Walk, two larvae were collected on *C. berlandieri* which produced one male and one female 17 May. At a roadside park on U. S. Highway 277 south of Del Rio near the county line, two larvae were found 17 August 1963 on *A. hybridus*. Larvae pupated 21 & 23 August. Adults emerged: 27 Aug. (1♀) and 29 Aug. (1♂).

Zavala Co.: 18 August 1963. At Batesville, three larvae were collected on *A. hybridus*. One larva which was thought to be ready to pupate, escaped when left exposed overnight. The other two pupated 23 & 29 August. Adults emerged: 28 Aug. (1♀) and 4 Sept. (1♂).

Larval habits of this species are quite interesting. The first instar larva folds over a small portion of the leaf as a shelter. It leaves the shelter to

feed. Upon returning home, the larva rests with its anal end near the open door. It now leisurely digests the consumed forage and ejects frass some distance from the shelter.

Celotes nessus (Edwards). The streaky skipper flies from March to November in Texas. Earliest and latest dates on which *C. nessus* has been taken by the writer are 9 March and 12 November. Reared specimens have emerged as late as 25 November. Kendall (1959) gave *Abutilon incanum* (Link) Sweet as a larval food plant for *nessus*. As a result of additional research four more species of malvaceous plants are now reported: *Althaea rosea* L., *Sida filipes* Gray, *Sphaeralcea lobata* (Woot.) Kearney (*det.* Dr. B. H. Warnock, Sul Ross State College), and *Wissadula amplissima* (L.) R. E. Fries.

Bexar Co.: 9 May 1963. Examination of *S. filipes*, which had been planted in the laboratory garden a year earlier, disclosed three larvae of *nessus* feeding on it. They were taken into the laboratory and reared to maturity on this plant. The first larva pupated 31 May. Adults emerged: 8 June (1♂), 14 June (1♂), and 11 July (1♀).

Blanco Co.: 3 May 1963. On U. S. Highway 281 at Little Blanco River, two larvae were found on *Abutilon incanum*. These larvae were later lost due to improper care in the laboratory.

Bosque Co.: 22 September 1962. At Meridian State Park five larvae were collected on *A. incanum*, but one soon died. The first two of these larvae pupated 9 & 10 October. Adults emerged: 17 Oct. (1♂), 18 Oct. (1♂), 24 Oct. (1♂), and 14 Nov. (1♂).

Cameron Co.: 21 April 1962. At the Laguna Atascosa National Wildlife Refuge three larvae were collected on *W. amplissima*. The plant on which these larvae were found was almost dormant due to drought. Two of the larvae pupated in due course; a male emerged 15 May and a female 4 June. The third larva entered diapause about 6 May. Examination 11 August disclosed the larva quite blanched and shrunken. In an attempt to break this diapause the larva was placed on a piece of moist cotton and placed near the laboratory window where the afternoon sun could strike it. Examination the following day showed the larva had not only become elongated, it had secured the leaf, under which it was hiding, to the cotton with strands of silk. The larva pupated 13 August, which was the twenty-first consecutive day of local temperatures equal to or greater than 100° F. A male emerged 20 August 1962.

Comal Co.: 27 July 1963. Near New Braunfels one larva was found on *A. incanum*. Larva pupated 23 August and a male emerged 30 August.

Jeff Davis Co.: 1 May 1961. At Davis Mountains State Park ova and larvae were found on *S. lobata*. Lou E. Walker, Park Manager, kindly permitted me to remove some of these "weeds" for transplanting. The plants survived the long journey back to the laboratory but they failed to recover in time to serve the intended purpose. It was now necessary to offer the larvae a substitute. *A. rosea* was provided and found acceptable. The larvae matured in due course and adults emerged: 28 May (1♂); *ex ovis* 6 June (1♂), 9 June (1♀). All other immatures were preserved.

Kimble Co.: 20 July 1963. At Junction ten larvae were collected on *A. incanum*. Some of these were first instar. In the laboratory, four larvae proved to have been parasitized; the remaining six were then placed on a caged living plant 5 August. The plant was again carefully examined 20 August; all that could be found was an empty pupal case. Presumably ants had eaten the adult after it died; the same might have happened to the larvae.

Maverick Co.: 17 August 1963. At a roadside park on U. S. Highway 277 south of Quemado, one larva was collected on *A. incanum*. It later died, but the cause was undetermined.

McCulloch Co.: 14 August 1961. On U. S. Highway 377 at roadside park which marks the geographical center of Texas, two larvae were found on *A. incanum*. One of these died and the other pupated in due course and a female emerged 13 September 1961.

Nueces Co.: 10 November 1962. At Hazel Bazemore Park near Calallen, two larvae were collected on *A. incanum*. About the beginning of December the larvae entered diapause. An attempt to break larval diapause was made 16 April 1963. Larvae were placed on moist facial tissue and placed near a laboratory window where the morning sun struck them. Both larvae pupated 19 April with adults emerging 27 April (♂) and 28 April (♀).

San Patricio Co.: 26 April 1962. At the Welder Wildlife Foundation Refuge, 34 larvae were collected on *A. incanum*. They varied in age from first to last instar, the first of which pupated 2 May. Ten live pupae were provided for other scientific research. Adults emerged: 10 May (1♂), 11 May (2♂♂), 13 May (1♂), 15 May (1♀), 16 May (2♂♂, 1♀), 17 May (2♂♂), 18 May (1♀), 19 May (1♂), 23 May (1♂, 1♀), 24 May (1♂), 27 May (1♀), 1 June (2♀♀), 11 June (2♂♂). Again at the Welder Refuge 10 November 1962, two more larvae were found on this plant. These larvae entered diapause about 1 December. Examination of them on 3 April 1963 disclosed one larva to be dead. On 18 April the remaining larva was placed on moist cotton and put in a sunny spot; it pupated 23 April and a female emerged 4 May.

Travis Co.: 2 September 1960. At Zilker Park in Austin, 14 larvae were collected on *A. incanum*. Most of these matured in due course but no emergence records were maintained.

Uvalde Co.: 30 April 1961. On U. S. Highway 90 near Cline, two larvae were collected on *A. incanum*. These larvae were reared through and males emerged 21 & 26 May.

The distribution of *C. nessus* in Texas appears to be west of a line from Gainesville, Cooke County to Brownsville in Cameron County. The writer has collected *nessus* in eight other Texas counties: Atascosa 31 Mar. 1957, Bandera 2 Apr. 1959, Dimmit 6 June 1960, Guadalupe 26 Aug. 1962, Jim Wells 5 Apr. 1962, Kinney 22 Mar. 1961, Kleberg 22 Mar. 1961, and Wilson 15 Aug. 1959.

Heliopetes laviana (Hewitson). Although the laviana skipper has been taken throughout the year in the lower Rio Grande Valley of Texas, laboratory studies indicate a larval diapause. The best place to find *laviana* is around the edge of brushy areas where malvaceous plants grow. Immatures have been found in nature on *Abutilon abutiloides* (Jacq.) Garcke, *Sida filipes* Gray, and *Malvastrum americanum* (L.) Torr. (*det.* by Fred B. Jones). In the laboratory, larvae of *laviana* readily accepted *Abutilon incanum* (Link.) Sweet and *Wissadula holosericea* (Scheele) Garcke.

Cameron Co.: 24 October 1960. At the U.S.D.A. Research Center in Brownsville, a cursory examination of several experimental malvaceous plants disclosed one last instar larva on *A. abutiloides*. The larva was removed and reared through, thanks to Perry A. Glick, U.S.D.A. Entomologist. The larva pupated 3 November and a male

emerged 14 November 1960. Again at Brownsville, near the NW edge of the city where U. S. Highway 281 crosses a railroad, one larva was collected on *A. abutiloides*, 17 October 1963. The writer was accompanied by Mrs. Kendall and Dr. J. W. Tilden. This larva pupated 23 October and a female emerged 4 November 1963.

Hidalgo Co.: 23 October 1960. Along an irrigation canal south of Mission, near the village of Madero, one larva was collected on *A. abutiloides*. Also the same day, four more were collected near Weslaco on this plant. One larva and one pupa were preserved. Pupation occurred from 29 October to 13 November. Adults emerged: 8 Nov. (1♂), 17 Nov. (1♂), and 28 Nov. (1♂). On 16 October 1963, three larvae were found on *M. americanum* near an irrigation canal on U. S. Highway 281 at the south edge of Edinburg. Two larvae pupated 30 October and the third on 10 November. Adults emerged: 13 Nov. (2♀♀) and 24 Nov. (1♀).

Jim Wells Co.: 23 October 1960. On U. S. Highway 281 just north of Premont in a fencerow, one small larva was found on *A. abutiloides*. It died 30 October, probably due to improper care in the laboratory.

Live Oak Co.: 23 April 1961. At a roadside park on Texas Highway 9 near intersection of FM 534, one larva was collected on *S. filipes*. Larva readily accepted *W. holosericea* in the laboratory and pupated 5 May. A male emerged 16 May 1961.

San Patricio Co.: 21 August 1960. At Lake Corpus Christi State Park, four miles SW of Mathis, one larva was found on *A. abutiloides*. A return visit 10 September 1960 yielded 17 more larvae on this plant. The larvae ranged from first to last instar. These larvae pupated from 12–30 September. A series of immatures was preserved. Four males and five females emerged: 21 Sept. (1♀), 22 Sept. (1♂), 25 Sept. (1♂), 30 Sept. (1♀), 2 Oct. (1♀), 4 Oct. (1♂), 6 Oct. (2♀♀), and 10 Oct. (1♂).

At the same location on 26 December 1960, three more larvae were found. These appeared to be in diapause. They were transported 100 miles north of the location where found. Here they were placed outdoors without food. An examination 11 February 1961 disclosed one larva dead, a second very hungry and moving about, the third, quite small, appeared in good health. The two remaining larvae were now placed on a living *W. holosericea* plant. The largest ate a few bites then moved beneath a leaf; the other crawled beneath a leaf without eating. Reexamination 15 March showed the largest one had bonded a leaf to the side of the screened cage and cut the petiole free. The other could not be found. The exact pupation date was not observed but a female emerged 1 April.

The Lake Corpus Christi site was visited again 7 October 1961. One larva which was collected pupated 30 October and a female emerged 28 November 1961. In addition to the larva, a gravid female was collected. Confined with *A. abutiloides* from the spot, it deposited 18 ova. In the laboratory, this same female deposited 25 more eggs on *A. incanum*. Sixteen eggs and other immatures were preserved. Eggs started hatching about 6:30 P.M. CST 12 October. The larvae were offered *A. incanum* which they started eating about 90 minutes after hatching. Twenty-one larvae were inventoried 29 October. Except for one, all were then placed on a living *A. incanum* plant in the laboratory garden. The exceptional larva was kept in a laboratory environment where it pupated 6 December and a male emerged 18 December. An inventory on 23 December disclosed only 11 larvae on the living plant, all last instar. Another examination 14 January 1962, following a week of freezing temperatures (lowest 10° F.), showed all except two had perished. These two had fallen to the ground in their leaf nests. Taken into the laboratory, both pupated 31 January. A female emerged 19 February and a male on 20 February. Emergence most likely would have been a month later in the natural ecological environment.

The above rearings were conducted in Bexar County, about 100 miles north of the capture locality. Here the average date of first 32° F. freeze

in the fall is about two weeks earlier than where the larvae were collected. Additional research is necessary to determine what factors constitute the distribution barrier.

Systasea pulverulenta (Felder) larvae were also found on *A. abutiloides* at Lake Corpus Christi in September, 1960. After collecting a few, it became quite easy to distinguish the two lepidopterous species by the type of shelter constructed. *H. laviana* simply pulls leaves together or folds them over to form the shelter while *pulverulenta* systematically eats away part of the leaf edge before constructing the shelter. First instar larvae of *laviana* eat away the leaf surface then fold it over at the weakened spot to form a protective shelter.

Heliopetes macaira (Reakirt). The macaira skipper is well established in the lower Rio Grande Valley of Texas. From there it ranges up the coast to San Patricio County. Freeman (1951) found it flying throughout the year in Hidalgo County. Its habitat is wooded or brushy areas where Turk's cap, *Malvaviscus drummondii* T. & G., its larval food plant, grows. This deciduous plant may be found in semishady spots over most of central and southern Texas, but *macaira* appears to be confined to an area in southern Texas where the frost-free growing season is 300 days or more; see Hildreth & Orton (1963).

Although *H. macaira* was described in 1866, it is believed that nothing has been published on its larval food plants or life history. Based on limited rearing, an immature diapause is not indicated. Growth and development of immature stages is, however, retarded by temperatures under 60° F. Seven reared examples disclosed the immature life-span ranged from 71 to 150 days. Further investigation may show even a greater range. The life of each example, in days and in the order of occurrence, is summarized: EGG TO ADULT: 71 (♂), 90 (♀), 99 (♂), 106 (♀), 116 (♂), 148 (♂), and 150 days (♂). EGG TO PUPA: 63, 68, 88, 98, 108, 126, and 134. DAYS IN PUPAL STAGE ONLY: 8, 12, 11, 8, 8, 22, and 16.

First instar larvae eat buds, blossoms, fruits, and juvenile leaves. A formal shelter is not constructed. Larvae hide in blossoms, brackets around fruits and blossoms, dead leaves on the plant, or any other convenient place. Older larvae may construct a shelter or simply seek the ground when not feeding. One observed larva climbed halfway up the plant to eat then returned to the ground and rested on a fallen leaf, unprotected there except for its excellent camouflage. It finally pupated on bare ground. Most larvae, however, pupate in a makeshift shelter secured at the cremaster. Those that do make shelters do so by pulling

leaves together with strands of silk. The petiole of one leaf is then cut into. When it dries, this leaf forms a roof over the nest.

San Patricio Co.: 4 July 1963. At the Welder Wildlife Foundation Refuge, along a trail near the Aransas River, a female was observed to oviposit on *M. drummondii*. Mrs. Kendall and the writer had thought for a year or more that this might be the larval food plant, but this was the first substantiating evidence. Mrs. Kendall caught the insect, also recovered the egg. In the laboratory, 34 more ova were deposited on terminal twigs and blossom buds of this plant. Eggs started hatching 9 July. Second instar larvae were placed on a living plant in the laboratory garden. On 28 August only one larva could be found. Ants were suspect. The one survivor pupated 5 September and a male emerged 13 September.

Again at the Welder Refuge, 13 October 1963, five egg-laying females were observed. One captive female deposited numerous eggs on *M. drummondii* twigs during the following three days. Eggs soon hatched and the larvae were doing quite well until a hard freeze killed the larval food plant early in December. A month later larvae had begun dying from starvation. On 15 January a few plants were found which had been protected from frost by oak trees. This was more than 100 miles north of the capture locality. Provided fresh leaves, three larvae continued to eat and mature. Two of these lived long enough to feed on new growth put forth on potted plants under glass. Pupation occurred: 20 Dec. (1), 10 Jan. (1), 17 Jan. (2), 20 Jan. (1), 30 Jan. (1), 17 Feb. (1), and 24 Feb. (1). The 17 January pupae were forwarded to Dr. C. L. Remington for chromosome studies. Adults emerged: 1 Jan. (1♀), 21 Jan. (1♂), 28 Jan. (1♀), 7 Feb. (1♂), 10 Mar. (1♂), and 11 Mar. (1♂). Specimens representing various immature stages were preserved.

Pyrgus communis communis (Grote). The checkered skipper is common at times throughout Texas. In the southern part of the State, it has been collected each month of the year. It is least likely to be found in January, May, and December. Immatures have been collected on seven malvaceous plants: *Callirhoe leiocarpa* Martin, *Sida* (*diffusa*) *filicaulis* T. & G., *Sida lindheimeri* Gray, *Sida rhombifolia* L., *Sphaeralcea angustifolia* (Cav.) D. Don, *Sphaeralcea cuspidata* Gray, and *Sphaeralcea lindheimeri* Gray. In the laboratory, it was reared on *Althaea rosea* Cab.

Bandera Co.: 2 April 1959. On Park Road 37, a female was observed to oviposit on *S. filicaulis*. The plant was very small; the egg was preserved.

Bexar Co.: 18 November 1956. In San Antonio, a female was observed to oviposit on *S. rhombifolia*. Eggs were being deposited on the underside of leaves next to the ground, one at a time, on very small plants. Examination of several plants disclosed one larva feeding from within a folded leaf shelter. All immatures were lost. Wild females were again observed to oviposit on *S. rhombifolia* 28 August and 13 September 1957; ova were not collected. Still another female, collected 16 November 1958 while ovipositing on *S. rhombifolia*, deposited seven ova under laboratory conditions; the first instar larvae were preserved. Another female was observed to oviposit 30 August 1959 on *S. rhombifolia*; the eggs were left in the field. On 26 February 1961, a wild female deposited eggs on the blossom buds of *C. leiocarpa* growing in the laboratory garden; the eggs were not collected. On 20 August 1961, a female was seen to fly from one plant to another ovipositing on *S. rhombifolia*; the eggs were not collected. Three larvae were found 20 April 1963 on *S. angustifolia* growing in the laboratory garden. This plant had been transplanted from Jeff Davis County two years earlier. Larvae pupated 27 & 28 April and 1 May. Adults emerged: 6 May (1♀), 7 May (1♀), and 13 May (1♀). Again on 5 October

1963, two females were seen ovipositing on S. *rhombifolia* in the laboratory garden.

Caldwell Co.: 10 June 1961. At the intersection of U. S. Highways 90 and 183, a female was observed to oviposit on *Sida lindheimeri.* Examination disclosed two larvae on the plant. The egg and one larva were lost before returning to the laboratory, but there the second larva accepted *A. rosea.* It pupated 26 June and a male emerged 4 July 1961.

El Paso Co.: 15 June 1960. On U. S. Highway 80, SE of El Paso near the county line, a female was observed while ovipositing on S. *angustifolia*; the egg was not collected. The female was captured but failed to oviposit under laboratory conditions.

Maverick Co.: 17 August 1963. At a roadside park on U. S. Highway 277 near Quemado, a female was seen to oviposit on S. *cuspidata*; neither the egg nor female were collected.

San Patricio Co.: 14 September 1963. At the Welder Wildlife Foundation Refuge, four larvae were found on *Sphaeralcea lindheimeri* and one on *Sida rhombifolia.* The *Sida* feeder pupated 19 September and a male emerged 27 September. The other larvae pupated 17, 18, and 20 September with adults emerging: 25 Sept. (1♂) and 26 Sept. (3♀♀); one larva died. At the same location, a female was observed ovipositing on S. *rhombifolia* 12 October 1963; it was not collected.

Val Verde Co.: 11 May 1961. At Lake Walk, nine larvae were found on S. *cuspidata,* one of which proved to be parasitized. The remaining eight larvae pupated in due course with adults emerging: 14 May (1♂, 2♀♀), 18 May (1♂), 20 May (1♂), 21 May (1♂), and 26 May (2♀♀).

The writer has collected *P. communis* in 38 other Texas counties representing all major botanical areas of the State.

Erynnis baptisiæ (Forbes). The distribution of the wild indigo dusky wing in Texas is not too well known at present, nor are the number of broods clearly defined. Freeman (1951) collected it in Dallas County in March, April, May, and August. He also observed females oviposit on *Baptisia tinctoria* R. Br., a cultivated species in Texas (Bailey, 1924), and reared larvae through on this plant. In the botanical Pineywoods area of eastern Texas where an abundance of five native *Baptisia* species may be found (Gould, 1962), the skipper has not been collected. An additional location by the present writer will bring to date all of the known records of *baptisiæ* from Texas.

Nueces Co.: 1 September 1962. Near the Nueces County Park on Padre Island below Corpus Christi, a number of adults were observed flying about, some of them visiting wild flowers. A female was observed to oviposit on *Baptisia laevicaulis* (Gray) Small. It was collected and kept for egg laying in the laboratory. Another female was collected on blossoms of *Helianthus argophyllus* (Torr. & Gray). Examination of several *B. laevicaulis* plants disclosed many eggs. The captive female deposited but five eggs before dying. Due to difficulty of keeping larval food plant fresh, only three were reared to maturity and these emerged: 30 Sept. (2♂♂) and 1 Oct. (1♀). Immatures were preserved.

Erynnis horatius (Scudder & Burgess).[2] In Texas this skipper flies from February to November. Reared specimens have emerged in De-

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[2] Special thanks go to Dr. John M. Burns, Wesleyan University, who determined or verified the writer's determination of the reared material in this study.

cember and January, but perhaps there are only three broods. It may be found around the edge of wooded areas where oak grows.

Dr. Alexander B. Klots (1951) points out that an old description of Chapman's lists wisteria while Grossbeck and Watson listed oak as the larval food plant. He writes further that, "Someone should check this." The purpose of this report is to present the results of widespread sampling in Arkansas, Louisiana, and Texas for immatures of this skipper. These collections, taken over a period of several years (1958–1963), have yielded sufficient immatures to remove any doubt that oak is a larval food plant. During this same period, wisteria has been under constant surveillance with negative results.

Immatures were found in nature on the following species of oak: *Quercus fusiformis* Small (Texas), *Q. hemisphærica* Bartr. (Louisiana), *Q. laurifolia* Michx. (Texas), *Q. marilandica* Muenchh. (Texas), *Q. nigra* L. (Ark., La., Tex.), *Q. phellos* L. (Texas), *Q. stellata* Wang. (Ark., La., Tex.), *Q. texana* Buckl. (Texas), *Q. virginiana* Mill. (Texas). In the laboratory, larvae readily accepted *Q. shumardii* Buckl. and *Q. gambelii* Nutt. Perhaps all species of oak are acceptable. *Q. laurifolia* was determined by Fred B. Jones, all other species by Dr. C. H. Muller, University of California, Santa Barbara.

IMMATURE STAGES. Ova are bonded singly to the tiny juvenile leaves in the tips of new growth. First instar larvae are incapable of eating other than very tender new leaves. This became apparent after witnessing a number of casualties from eggs found in nature. While second instar larvae will survive on older leaves, larval growth appears to be stimulated by more tender foliage. This holds for the entire larval cycle. In certain geographical areas the collector may find gravid females prefer a single species of oak due to the frequency of new growth.

After progressing through four instars, larvae pupate in leaf shelters. The exuvium is eaten after each molt. First and second instar larvae construct very distinctive shelters. The larva makes a bilateral cut near the outer end of the leaf, approximately 45° to the center vein. The tip is then folded over, never under, where it is held in place by strands of silk. When resting, the larva hangs inverted from the top of the shelter. It eats away the edges of the roof and sometimes the foundation. A new shelter is constructed as required to meet growth and development. Last instar larvae usually pull together two leaves, if small, for the shelter. If the leaves are large, the edge may be rolled over to form the shelter. While larval diapause is indicated, some reared immatures remained in the pupal stage for more than two months.

To find ova and larvae in nature one must first locate oaks with tender

new growth. Small cut-over bushes are the best, but large trees will also yield larvae of *E. horatius*. The collector will find, however, that as the plant size decreases, success in locating larvae increases. This correlates well with the usual low flight of imagos. If there are no small bushes in the collecting area, the branches of larger trees should be examined for new growth. The uppermost growth of small saplings, six to eight feet, will prove rewarding. After a little practice the lepidopterist will recognize a larval shelter as far away as it can be seen.

The best places to find immatures of *horatius* are along rights-of-way, railroad and highway, where the brush is cut once or twice each year, on well-drained slopes and sunny locations. Wooded areas are not so rewarding unless there is an open trail admitting plenty of sunlight. A desirable trail is one that follows a power or pipeline through a wooded area. Here the vegetation is usually cleared away periodically, which causes new growth to appear on the cut-over oaks.

PARASITES AND PREDATORS. Spiders and parasites continually remove many *horatius* in the field. Collections are best made soon enough after eggs have been deposited when greater numbers of small larvae are to be found. Predatory insects and birds undoubtedly get a fair proportion, but, by and large, crab spiders take the greatest toll. For each larva found in nature the collector may expect to find 15 or more larval shelters occupied by arachnids. Parasites are next in order. Of the 298 field-collected larvae taken during this investigation, 33 were parasitized.

REARING TECHNIQUE. The juvenile leaves containing the eggs are removed from the main plant and placed in small containers. Containers should not be tightly covered until the juvenile leaves have completely dehydrated, otherwise fungus may develop and kill the embryo. When the eggs hatch, one or two larvae are permitted to crawl upon a small sprig of juvenile leaves and then are placed in a separate container. Overcrowding and heating should be avoided. Should fungus develop, the larvae are transferred to a fresh leaf immediately. The crucial period is the first instar. Second instar larvae may be transferred to larger containers. If closed jars are employed, they should be kept inverted. This will promote sanitation and facilitate removal of frass without disturbing the larvae. Constant room temperature is desirable in controlling condensation within the jar, but not essential. Larvae which are about to pupate or enter diapause should be removed to well-ventilated containers. The time to transfer is when the larva stops feeding and begins to lose its color. A large mouth jar with window screen insert and screened lid makes a good emergence cage. Most adults emerge in midafternoon or early evening.

ARKANSAS

Calhoun Co.: 28 September 1962. On U. S. Highway 167 at Champagnolle Creek, 26 larvae were found on *Q. nigra*. Three larvae were parasitized, another died in larval diapause, and a fifth died in the pupa. The first larva pupated 16 October; the last, on 30 December. Ten males and eleven females emerged: 27 Oct. (1♂), 29 Oct. (1♂), 30 Oct. (2♂♂, 1♀), 2 Nov. (2♂♂, 1♀), 3 Nov. (2♂♂), 7 Nov. (1♂), 10 Nov. (1♀), 11 Nov. (1♀), 12 Nov. (1♂, 1♀), 17 Nov. (1♀), 21 Nov. (1♀), 22 Nov. (1♀), 27 Nov. (1♀), 30 Nov. (1♀), 12 Jan. 1963 (1♀).

Columbia Co.: 17 September 1959. On U. S. Highway 82 near Waldo, one parasitized larva was found on *Q. nigra*.

Jefferson Co.: 26 September 1962. In Oakland Park at Pine Bluff, two larvae were recovered from *Q. nigra*. One of these died 9 October the other 20 October; cause unknown. The following day, 27 September, 16 larvae were collected on *Q. nigra* and *Q. stellata* just south of the city off Ohio Street. Seven of these larvae were parasitized and another died while in diapause. The first larva pupated 21 October 1962 and the last, 9 March 1963 after larval diapause. Five males and three females emerged: 2 Nov. (1♂), 4 Nov. (1♂), 6 Nov. (1♂), 10 Nov. (1♀), 15 Nov. (1♂), 22 Nov. (1♀), 28 Nov. (1♀), and 27 Mar. 1963 (1♂).

Union Co.: 16 September 1959. At a small community park in El Dorado, 17 larvae were collected on *Q. stellata*. These larvae were reared through on *Q. shumardii*. Three died, one was parasitized, and one larva and one pupa were preserved. Five males and six females, emerged: 23 Oct. (1♂), 25 Oct. (1♂), 2 Nov. (1♂), 3 Nov. (1♀), 6 Nov. (1♀), 11 Nov. (1♀), 13 Nov. (1♂, 1♀), 22 Nov. (1♀), 29 Nov. (1♀), 3 Dec. (1♂).

LOUISIANA

Calcasieu Parish: 24 November 1960. In an area just east of Lake Charles, eight larvae were found on cut-over *Q. hemisphærica*, *Q. stellata*, and *Q. nigra* bushes along a dirt road. Five of these proved to be parasitized. One larva entered diapause early in December, it pupated 17 January 1961 and a female emerged 18 February. The other two larvae pupated 26 December; a female emerged 9 February, and a male on 12 February 1961.

Sabine Parish: 15 September 1959. On U. S. Highway 171 near Zwolle, five larvae were collected on *Q. stellata*; they were transferred to *Q. shumardii* on 19 September and reared through. One larva was preseved; others pupated: 16 Oct., 5 Nov., 17 Nov., and 11 Dec. Adults emerged: 31 Oct. (1♂), 21 Nov. (1♀), 2 Dec. (1♂), and 29 Dec. (1♀).

Vernon Parish: 4 November 1958. On U. S. Highway 171 about three miles north of Leesville, three larvae were found on small *Q. nigra* bushes growing along the right-of-way. One larva died, the other two pupated 11 & 14 January 1959. A female emerged 1 February and a male on 6 February. At the same location, 13 September 1959, 12 more larvae were collected. One of these was parasitized; the others pupated from 3 October to 30 November. Eight males and three females emerged: 18 Oct. (1♂), 25 Oct. (1♂, 1♀), 27 Oct. (1♂), 28 Oct. (1♂), 29 Oct. (1♀), 30 Oct. (1♂), 1 Nov. (1♂), 4 Nov. (1♂), 7 Nov. (1♂), 16 Dec. (1♀).

Webster Parish: 28 September 1962. On La. Highway 2A near Haynesville, 15 larvae were collected on very small *Q. stellata* bushes. One larva died of parasitism, three more from other causes. Eleven larvae pupated from 28 October to 13 January 1963. Six males and five females emerged: 9 Nov. (1♂), 10 Nov. (1♂), 16 Nov. (1♀), 25 Nov. (1♂, 1♀), 26 Nov. (1♂), 27 Nov. (1♂), 29 Nov. (1♂), 16 Dec. (1♀), 27 Dec. (1♀), and 26 Feb. 1963 (1♀).

Texas

Angelina Co.: 29 September 1962. On Texas Highway 103 near the Angelina River, six larvae were collected on *Q. stellata.* Pupation occurred from 20 October to 13 November. Three males and three females emerged: 2 Nov. (2♂♂), 6 Nov. (1♀), 11 Nov. (1♂), 25 Nov. (1♀), and 28 Nov. (1♀).

Bastrop Co.: 19 May 1962. At Bastrop State Park one larva was found on *Q. marilandica.* It continued to feed until 9 September; it pupated 12 September but died 21 September.

Bexar Co.: 11 January 1959. At Helotes, one larva was collected on *Q. fusiformis.* It appeared to be in diapause, but on 17 January it pupated and a female emerged 8 February.

On U. S. Highway 281 about 16 miles south of San Antonio, 5 larvae were found on *Q. virginiana* 11 September 1960. These larvae pupated from 2 October to 7 October. Two males and three females emerged: 12 Oct. (1♂), 13 Oct. (1♂, 1♀), 15 Oct. (1♀), and 17 Oct. (1♀).

In the northern portion of San Antonio just off U. S. Highway 87, four larvae were found on *Q. fusiformis,* 19 September 1960. One larva died and another was killed accidentally. The remaining two pupated 12 & 15 October; two females emerged, one 23 October the other 27 October.

Near Camp Bullis Military Reservation north of San Antonio, five ova and 12 larvae were found 2 October 1960 on *Q. fusiformis.* Eight of the larvae were lost, cause unknown; four pupated from 24 October to 14 November. Three males and one female emerged: 5 Nov. (1♂), 10 Nov. (1♂), 16 Nov. (1♂), and 2 Dec. (1♀). The eggs hatched soon after being brought into the laboratory, but three first instar larvae died. Another larva entered diapause but died later. The fifth pupated 4 December and a male emerged 23 January 1961.

In north San Antonio, two ova and nine larvae were found 29 October 1960 on seedling *Q. fusiformis.* The eggs hatched in due course, but the first instar larvae soon died. Two of the larvae collected in nature were preserved, the others pupated from 15 November to 10 December. Five males and two females emerged: 1 Dec. (1♂), 4 Dec. (1♀), 14 Dec. (1♂), 19 Dec. (1♀), 31 Jan. 1961 (1♂), 1 Feb. (1♂), and 13 Feb. (1♂).

San Antonio, a female collected 5 March 1961 was kept for laboratory experimentation. During the period 6–12 March, 98 eggs were deposited on juvenile leaves of sucker shoots of *Q. fusiformis.* Examples representing the complete life history, including 25 ova, were preserved. The eggs hatched 11–13 March; larvae pupated 7–20 April; 19 males and 16 females emerged: 23 Apr. (1♂), 24 Apr. (3♂♂), 25 Apr. (4♂♂, 1♀), 26 Apr. (4♂♂, 1♀), 27 Apr. (2♂♂, 4♀♀), 28 Apr. (1♂, 2♀♀), 29 Apr. (4♂♂, 4♀♀), 30 Apr. (1♀), 2 May (2♀♀), and 5 May (1♀).

About 12 miles NW of San Antonio, two larvae were found 17 June 1961 on *Q. fusiformis.* Pupation occurred 24 June and 8 July; a male emerged 3 July and a female on 17 July.

Blanco Co.: 24 September 1960. On U. S. Highway 281 north of Blanco, nine larvae were collected on *Q. texana* growing along the highway. One larva was being eaten by a crab spider when found; two more died of parasitism. The remaining larvae pupated from 15 October to 29 October; one pupa died. One male and four females emerged: 26 Oct. (1♀), 1 Nov. (1♂), 3 Nov. (2♀♀), and 11 Nov. (1♀).

Bowie Co.: 24 September 1962. On U. S. Highway 67 near Basset, one egg was collected on *Q. marilandica.* Egg hatched 26 September; larva pupated 15 December and a male emerged 6 January 1963. The larva was reared on *Q. fusiformis.*

Brazos Co.: 30 September 1962. Near the village of Kurten on Texas Highway 21, nine larvae were collected on *Q. stellata.* One larva preserved, the others pupated from 20 October to 7 November. Two males and six females emerged:

2 Nov. (1♀), 5 Nov. (1♂), 11 Nov. (1♀), 12 Nov. (2♀♀), 15 Nov. (1♀), 20 Nov. (1♀), and 23 Nov. (1♂).

Brooks Co.: 23 October 1960. At a roadside park on U. S. Highway 281 about 15 miles south of Falfurrias, four ova and six larvae were collected on *Q. virginiana*. Two larvae were parasitized; the others pupated from 18 November to 11 February 1961. One male and three females emerged: 3 Dec. (1♂), 24 Jan. (1♀), 17 Feb. (1♀), and 6 Mar. (1♀). Only one of the eggs hatched and that on 26 October; the larva pupated 1 December and a female emerged 9 January 1961.

Brown Co.: 13 August 1961. At Brownwood State Park, three larvae were collected on *Q. fusiformis*. Two larvae pupated 14 September, the third on 23 September. Adults emerged: 24 Sept. (1♂, 1♀) and 4 Oct. (1♂).

Caldwell Co.: 19 May 1962. At a roadside park on Texas Highway 142 near Maxwell, four larvae were found on *Q. stellata*. They pupated from 6–30 June. Three males and one female emerged: 15 June (1♂), 20 June (1♂), 28 June (1♂), and 11 July (1♀). At the same location and date, one other larva was found on *Q. marilandica*. It pupated 14 September but was accidentally punctured.

Chambers Co.: 22 March 1963. On IH 10 near FM 563, one egg was found on *Q. phellos*. It hatched 27 March, and the larva was reared on *Q. fusiformis*. It pupated 2 May and a female emerged 13 May 1963.

Colorado Co.: 10 November 1961. At a roadside park on U. S. Highway 90 about ten miles west of Columbus, two larvae were found on *Q. virginiana*; both were in diapause. One larva died; the other pupated 9 February 1962 and a male emerged 24 February.

Comal Co.: 27 December 1958. On County Road 311 near Spring Branch, one larva in diapause was found on *Q. fusiformis*. It pupated 15 January 1959 and a male emerged 7 February. On Guadalupe River road about five miles NW of New Braunfels, one larva was collected on *Q. fusiformis*, 27 July 1963. It pupated 14 August and a male emerged 24 August.

Gillespie Co.: 25 September 1960. On Texas Highway 16 about five miles NE of Fredricksburg, two ova and one larva were collected on *Q. texana*. The eggs hatched 28 September, but first instar larvae were soon lost due to improper care. The larva found in nature pupated 27 October and a male emerged 8 November.

Gonzales Co.: 10 June 1961. One larva was found at Palmetto State Park, and three more near the park on *Q. marilandica*. These larvae pupated from 6 July to 1 August. Three males and one female emerged: 15 July (1♂), 16 July (1♂), 25 July (1♀), and 13 Aug. (1♂).

Guadalupe Co.: 11 June 1961. At a roadside park on U. S. Highway 90 near Kingsbury, two larvae were collected on *Q. stellata*. One larva pupated 5 July and a male emerged 14 July. The other larva continued to feed. On 13 August the writer and Mrs. Kendall departed for Crested Butte, Colorado and took the larva along. It was offered *Q. gambelii* 14 August which it ate. Feeding stopped 3 November and larva entered diapause, but it died in January, 1962 before pupation occurred.

Hamilton Co.: 22 September 1962. On Texas Highway 22 at the Leon River, one larva was found on *Q. texana*. It pupated 18 October and a male emerged 29 October.

Harris Co.: 26 November 1960. Along Memorial Drive in Houston, two larvae, killed by crab spiders, were found on *Q. stellata*. Many larval shelters were present.

Harrison Co.: 29 September 1962. At Caddo Lake State Park, three larvae were found on seedling *Q. stellata* and *Q. marilandica*. They pupated 23 October, 28 October, and 8 November; one died later. A male emerged 9 November and another male 23 November.

Henderson Co.: 2 September 1963. Three larvae were found near Athens and

seven more near Malakoff, all on *Q. stellata*. One larva proved to be parasitized and another was killed accidentally. The remaining larvae pupated from 9 September to 9 October. Two males and six females emerged: 17 Sept. (1♀), 25 Sept. (1♀), 7 Oct. (1♀), 9 Oct. (1♀), 12 Oct. (1♂), 13 Oct. (1♂), 15 Oct. (1♀), and 19 Oct. (1♀).

Jefferson Co.: 9 November 1961. At a roadside park on Texas Highway 124 about three miles south of Fannett, three last instar larvae were found on *Q. nigra*. One larva was in diapause and the other two stopped feeding about 17 November. Larvae pupated 8 & 10 February 1962. Adults emerged: 21 Feb. (2♂♂) and 23 Feb. (1♀).

Kendall Co.: 25 September 1960. About two miles north of Comfort on U. S. Highway 87, one pupa and four larvae were collected on *Q. texana*. The pupa died, and one larva was parasitized; both were preserved. The remaining three pupated 6, 11, & 16 October. Three males emerged 16, 21, & 27 October.

Kerr Co.: 27 June 1963. On Johnson Creek near Ingram, six larvae were collected on *Q. texana*. Four larvae were lost; the remaining two pupated in due course; a male emerged 22 August and a female on 31 August.

Lee Co.: 30 September 1962. At a roadside park on Texas Highway 21 near Lincoln, one larva was found on a sucker shoot of *Q. marilandica*. It pupated 10 November and a male emerged 22 November.

Leon Co.: 4 September 1960. Between Long Lake and Oakwood near the Trinity River on U. S. Highway 79, three larvae were collected on *Q. stellata*. Larvae pupated 2, 8, & 10 October. Adults emerged: 12 Oct. (1♀), 18 Oct. (1♂), and 20 Oct. (1♀).

Live Oak Co.: 22 October 1960. On U. S. Highway 281 at San Christoval Creek near intersection of FM 2049, three larvae were found on *Q. virginiana*. Two entered diapause. Pupation occurred 18 November 1960, 9 January, and 3 February 1961. Adults emerged: 5 December (1♀), 16 Feb. (1♀), 4 Mar. (1♀).

McCulloch Co.: 14 August 1961. At a roadside park on U. S. Highway 377 which marks the geographical center of the State, two larvae were found on *Q. fusiformis*. One died of parasitism, the other pupated 23 September and a male emerged 2 October.

Nueces Co.: 1 September 1962. At Flour Bluff one larva was found on *Q. laurifolia*. It pupated 1 October and a female emerged 11 October.

Robertson Co.: 2 September 1960. At a roadside park near New Baden on U. S. Highway 79, one pupa and four larvae were collected on *Q. stellata*. Two days later 18 larvae were collected on *Q. stellata* at Ridge. A male emerged from the pupa on 8 September. Three of the larvae died of parasitism and three more from other causes. Two pupae also died. Pupation occurred from 6 October to 5 November. Seven males and seven females emerged: 16 Oct. (1♀), 18 Oct. (2♂♂), 22 Oct. (1♀), 23 Oct. (1♀), 25 Oct. (1♂, 1♀), 26 Oct. (1♀), 27 Oct. (1♂), 29 Oct. (1♂), 31 Oct. (1♂), 2 Nov. (1♀), 6 Nov. (1♀), and 18 Nov. (1♀).

San Jacinto Co.: 4 November 1961. Near Oakhurst one larva was collected on *Q. nigra*. Numerous empty larval shelters were present. The larva pupated 12 February after a diapausal period of more than two months. A female emerged 26 February 1962.

San Patricio Co.: 11 September 1960. Along the railroad near Ingleside, 19 larvae were found on *Q. laurifolia* and *Q. virginiana*. Six were preserved; the remaining larvae pupated from 6 October to 21 October. Six males and seven females emerged: 16 Oct. (1♂), 18 Oct. (1♂), 19 Oct. (1♀), 22 Oct. (1♂), 23 Oct. (1♂), 24 Oct. (1♂, 1♀), 25 Oct. (1♂, 1♀), 26 Oct. (1♀), 29 Oct. (1♀), 30 Oct. (1♀), and 31 Oct. (1♀). At the Welder Wildlife Refuge, two larvae were found 10 November 1962 on *Q. virginiana*. Both larvae entered diapause, and the exact

population dates were not observed. A female emerged 12 March and another female on 18 March 1963.

Shelby Co.: 29 September 1962. At a roadside park on U. S. Highway 96 near Center, nine larvae were collected on *Q. nigra*. One was parasitized and another was lost. The remaining larvae pupated from 22 October to 25 November. Five males and two females emerged: 3 Nov. (1♂), 20 Nov. (1♀), 22 Nov. (1♂), 23 Nov. (2♂♂), 3 Dec. (1♀), and 14 Dec. (1♂).

Smith Co.: 4 September 1960. On Texas Highway 64 at a roadside park about 12 miles west of Tyler, eight larvae were collected on *Q. marilandica*. Four of these died of parasitism and two from other causes. The remaining two pupated 9 & 17 October. A female emerged 18 October and another female on 28 October 1960.

Tyler Co.: 4 November 1961, near Woodville a single larva was found on *Q. stellata*. It stopped feeding 13 November, entered diapause, and died about 12 February 1962, apparently from dehydration.

Upshur Co.: 1 September 1963 at Big Sandy, four ova were found on juvenile leaves of *Q. stellata*. Two of the eggs appeared to have just hatched, but the first instar larvae could not be found. The other two eggs hatched and the larvae were lost before returning to the laboratory.

Victoria Co.: 25 December 1960. At a roadside park on U. S. Highway 59 just inside the Goliad–Victoria County line, one larva in diapause was collected on *Q. virginiana*. It pupated 8 February 1961, and a male emerged 4 March 1961.

Walker Co.: 4 September 1961. At Huntsville State Park, one larva was found on *Q. nigra*. It was reared on *Q. fusiformis*, pupated 30 October, and a male emerged 22 November.

Wood Co.: 31 August 1963. On FM 14 at the Sabine River, one egg and five larvae were collected on *Q. nigra*. The egg hatched, and the first instar larva was lost before reaching the laboratory several days later. One of the larvae collected in nature died and another was accidentally killed. The remaining three pupated 26 September, 23 October, and 12 December. One male and two females emerged: 7 Oct. (1♂), 5 Nov. (1♀), and 7 Jan. 1964 (1♀).

Zavala Co.: 18 August 1963. At Batesville, one larva was collected on *Q. virginiana*. It pupated 20 September and a male emerged 28 September.

The writer has collected adults in seven other Texas counties: Aransas (3 Apr. 1960, 20 Aug. 1960), Bandera (2 Apr. 1959), Bosque (22 Sept. 1962), Bee (3 Sept. 1962), Grimes (29 June 1957), Polk (14 Apr. 1962), and Uvalde (10 Mar. 1962).

Gesta gesta invisus (Butler & Druce).[3] Although the gesta dusky wing is rare in collections, it is well established in southern Texas. Here it is closely associated with the larval food plants *Indigofera suffruticosa* Mill. and *Indigofera lindheimeriana* Schelle. The distribution of *Gesta* in Texas correlates well with the distribution of these two plants as given by Turner (1959). Except for July, *gesta* has been field collected in Texas from April to November. Reared specimens have emerged in January, March, and December. The species has a larval diapause. Its flight period should be from late March to late November depending on climatic conditions of any specific location. Four broods are indicated. Larvae entering diapause construct a nest on the ground under fallen

[3] Determination by Dr. John M. Burns.

leaves. Other larvae often pupate in a leaf nest on the growing plant.

Comstock & Garcia (1961) found larvae on *Cassia* sp. in Mexico, reared them through, and illustrated the last instar larva and pupa.

Colorado Co.: 30 November 1963. On U. S. Highway 90A near Sheridan, a good stand of *I. suffruticosa* was located in an abandoned field. All except the terminal leaves had fallen. A cursory examination disclosed two unmistakable shelters on one plant.

Comal Co.: 3 August 1963. At the second low water bridge across the Guadalupe River NW of New Braunfels, five larvae and one pupa were found on *I. lindheimeriana*. Very small plants had been selected by the egg-laying females. A male emerged from the pupa on 8 August. One larva died, the other four pupated between 9 & 18 August. Three males and one female emerged: 15 Aug. (1♂), 16 Aug. (1♀), 21 Aug. (1♂), and 24 Aug. (1♂). These specimens completed their larval stage on *I. leptosepala* (Nutt.) Turner. No larvae have been found in nature on this species of *Indigofera*. At the same locality, three larvae were collected 9 May 1964. One larva failed to complete pupal transformation. The remaining two pupated 13 & 18 May. Adults emerged 21 May (♂) and 26 May (♀).

Kendall Co.: 28 June 1963. While on a joint field trip with Dr. John M. Burns, we collected in an area beneath U. S. Highway 87 bridge across the Guadalupe River at Comfort. There, Dr. Burns found one last instar larva on a small *I. lindheimeriana* plant and the larva was preserved for his further study.

San Patricio Co.: 11 November 1962. At the Welder Wildlife Refuge, 26 larvae and several eggshells were found on *I. suffruticosa*. A return visit 20 November yielded 27 more larvae on this plant. One larva was parasitized; a few were preserved. These evidently were the first immatures of *G. gesta* to be collected in the United States. Pupation occurred from 8 December 1962 to 16 April 1963, most of which were preceded by larval diapause. Twenty-five males and 23 females emerged: 21 Dec. (1♀), 23 Dec. (1♂, 1♀), 26 Dec. (2♂♂), 1 Jan. (2♀♀), 2 Jan. (1♀), 22 Mar. (1♂, 1♀), 24 Mar. (1♂), 29 Mar. (1♀), 31 Mar. (3♂♂), 1 Apr. (1♂, 3♀♀), 2 Apr. (1♂, 2♀♀), 3 Apr. (1♂), 4 Apr. (3♀♀), 6 Apr. (2♂♂), 7 Apr. (6♂♂, 1♀), 8 Apr. (3♀♀), 9 Apr. (1♂, 1♀), 10 Apr. (1♂, 2♀♀), 13 Apr. (2♂♂), 15 Apr. (1♂, 1♀), and 26 Apr. (1♂).

At Ingleside on 21 November 1962, ten unhatched eggs, 67 larvae, and one pupal case were found on *I. suffruticosa*. The eggs and a series of other immature stages were preserved. Live pupae were furnished to Dr. C. L. Remington for chromosome studies. Larvae pupated from 4 December 1962 to 2 April 1963 after an extended larval diapause for most. Nineteen males and 25 females emerged: 18 Dec. (1♀), 19 Dec. (1♀), 20 Dec. (1♀), 21 Dec. (1♀), 23 Dec. (2♂♂), 24 Dec. (2♀♀), 28 Dec. (1♂, 1♀), 23 Mar. (1♀), 26 Mar. (1♂), 27 Mar. (1♂, 3♀♀), 30 Mar. (1♀), 31 Mar. (1♂, 2♀♀), 2 Apr. (4♀♀), 3 Apr. (2♂♂), 4 Apr. (1♂, 3♀♀), 6 Apr. (6♂♂, 1♀), 7 Apr. (2♂♂, 1♀), 8 Apr. (1♀), 9 Apr. (1♂), and 12 Apr. (1♀).

At the Welder Wildlife Refuge, 3 July 1963, three pupae were collected on *I. suffruticosa*; all proved to be parasitized. Again at the Welder Refuge, 14 September 1963, 22 larvae were collected on the same individual plant that yielded 26 larvae on 11 November 1962. Four of these later larvae entered diapause; the remaining 18 pupated from 16 to 25 September. Nine males and nine females emerged: 23 Sept. (1♂), 24 Sept. (1♂), 25 Sept. (2♂♂, 3♀♀), 26 Sept. (2♂♂), 27 Sept. (1♂, 2♀♀), 28 Sept. (1♂, 1♀), 1 Oct. (1♂, 1♀), 2 Oct. (1♀), 3 Oct. (1♀). Once again at the Refuge, 14 October 1963, both adults and immatures were found common by the writer, accompanied by Dr. J. W. Tilden. Three larvae pupated shortly and emerged: 8 Nov. (1♂), 9 Nov. (1♂), and 13 Nov. (1♂). The other larvae started pupating in early March, 1964 following larval diapause. One male

and 8 females emerged: 17 Mar. (1♀), 30 Mar. (1♀), 8 Apr. (1♀), 14 Apr. (1♂, 1♀), 15 Apr. (1♀), 17 Apr. (1♀), 20 Apr. (1♀), and 23 Apr. (1♀).

Uvalde Co.: 17 August 1963. At a roadside park on U. S. Highway 90 where it crosses the Nueces River, several unmistakable larval shelters were found on *I. lindheimeriana.* These plants were growing in the rocky overflow portions of the riverbed. A more diligent search would undoubtedly have yielded immatures. Freeman (1951) collected one male and one female of *gesta* in Uvalde County 31 May 1942.

Wilson Co.: 15 August 1959. On U. S. Highway 87 at the Cibolo River, two adults were collected while feeding on blossoms of *Phyla nodiflora* (L.) Greene. About one mile NW of Floresville, 20 October 1963, one fresh male was collected and numerous larvae were found on *I. suffruticosa.* Nine larvae were brought to the laboratory and reared through. Seven of these entered diapause; the other two pupated in due course, with a male emerging 4 November and a female 5 November. Two males and four females emerged following larval diapause: 4 Apr. (1♀), 16 Apr. (1♂, 1♀), 23 Apr. (1♀), 29 Apr. (1♂), and 30 Apr. (1♀). One pupa died.

Zavala Co.: 18 August 1963. On Texas Highway 76 at the Nueces River, one empty pupal case was found in a leaf nest on *I. lindheimeriana.* Only a single plant was to be found along the road. Fenced and posted property prevented further searching along the dry riverbed where the food plant would most likely occur.

Other Texas distribution records include the Aransas National Wildlife Refuge, Aransas County, where the writer collected one male and four females, 3 April 1960. Two individuals of *gesta* were observed at Hidalgo, Hidalgo County, 17 October 1963. Freeman (1951) collected a female at Pharr, Hidalgo County, 4 November 1945. He also collected a male at Kerrville, Kerr County, 3 June 1949. J. W. Tilden (*in litt.*) reports a male collected near Quemado, Maverick County, 8 October 1963 and ten males and ten females at the Welder Wildlife Refuge, San Patricio County, 14 October 1963.

Achlyodes thraso tamenund (Edwards). The sickle winged skipper flies throughout the year in extreme southern Texas, the area where its larval food plant is most abundant. In this area it is most common from mid-August to mid-November. At present it is unknown whether the adult overwinters or there is an immature diapause. At the Corpus Christi Park cited below, the oviposition process was observed on 21 August 1960. A few adults were seen about 9:30 A.M. CST; soon, many more were present as the temperature rose with the hot morning sun. The flight pattern of a few individuals around *Zanthoxylum fagara* (L.) Sarg. was indicative of females in search of larval food plants. Not more than five minutes later a female was observed ovipositing. After flitting about from one spot to another, a suitable leaf was selected, an egg quickly deposited on the upper surface, and then the skipper dashed off to repeat the process.

San Patricio Co.: 21 August 1960. At the Lake Corpus Christi State Park site four egg-laying females were taken alive for laboratory experimentation. Also, 24 larvae, two pupae, four empty pupal cases, and a number of ova were found in

nature on *Z. fagara.* A return visit to the spot 10 September 1960 yielded more than 110 larvae and 17 pupae. Hundreds of fresh adults were found swarming around blossoms of *Cynanchum unifarium* (Scheele) Woodson at this time. Because *Z. fagara* was not readily available at the laboratory, it was necessary to rely on refrigeration to keep fresh the food plant. For this reason it was considered impracticable to rear many from the numerous eggs deposited by the captive females. Consequently, many immatures were preserved. Of the larvae collected in nature, 25 males and 34 females were produced in 1960 as follows: 11 Sept. (1♂, 1♀), 13 Sept. (2♀♀), 14 Sept. (1♂, 1♀), 15 Sept. (1♀), 16 Sept. (1♂, 3♀♀), 17 Sept. (1♂, 2♀♀), 19 Sept. (2♂♂, 1♀), 20 Sept. (1♀), 21 Sept. (2♂♂, 1♀), 22 Sept. (2♂♂, 3♀♀), 23 Sept. (2♂♂, 5♀♀), 24 Sept. (1♂), 25 Sept. (3♂♂, 3♀♀), 26 Sept. (4♂♂, 1♀), 28 Sept. (1♂, 2♀♀), 29 Sept. (2♂♂, 2♀♀), 30 Sept. (1♂, 1♀), 1 Oct. (1♂, 1♀), 3 Oct. (1♀), 5 Oct. (2♀♀).

Live Oak Co.: 23 October 1960. At a roadside park on Texas Highway 9 near Oakville, one female was observed ovipositing on *Z. fagara.* One larva and three pupae were also found at this spot. Adults emerged, from the pupae: 27 Oct. (1♂), 29 Oct. (1♂), 1 Nov. (1♂), and a female from the larva 5 Nov. 1960. At this same roadside park 8 October 1961, another egg-laying female was seen and taken. It deposited 15 ova under laboratory conditions. The newly hatched larvae were placed on an uncovered *Z. fagara* bush growing in the laboratory garden. So far as could be determined none survived. Numerous predators were suspect.

Goliad Co.: 25 December 1960. At Goliad State Park, numerous pupal cases were found on *Z. fagara.*

Kleberg Co.: 26 December 1960. At the Kingsville City–County Park, one larva and many pupal cases were found on *Z. fagara.* The larva, thought to be in diapause, was not fed and it failed to survive.

Other Texas counties in which the writer has collected *A. tamenund* adults are: Bexar (18 Aug. 1957, 31 Mar. 1959, 2 Oct. 1960, & 21 Sept. 1961), Brooks (22 Oct. 1960), Cameron (2 & 3 Apr. 1957, 21 Mar. 1961, 22 Apr. 1962, 17 Oct. 1963), Comal (9 Aug. 1959), Hidalgo (22 Oct. 1960, 22 Nov. 1962, 16 Oct. 1963, 10 Nov. 1963), Jim Wells (22 Oct. 1960), Nueces (10 Nov. 1962).

Systasea pulverulenta (R. Felder). The so-called powdered skipper flies from February to November in southern Texas. The earliest and latest dates it has been taken in Bexar County are 9 February and 27 November. The exact number of overlapping broods has not been determined. Except for eight scattered days, reared adults emerged every day from 15 May to 12 July. Late season mature larvae enter diapause. Kendall (1959 & 1961) found *Wissadula holosericea* (Scheele) Garcke and *Abutilon wrightii* Gray to be larval food plants of *pulverulenta.* Four more malvaceous plants are now added: *Abutilon abutiloides* (Jacq.) Garcke, *Abutilon incanum* (Link) Sweet, *Sphaeralcea angustifolia* (Cav.) Don, and *Wissadula amplissima* (L.) R. E. Fries. *W. holosericea* seems to be the first choice of egg-laying females, *A. incanum* the least desirable. As mentioned in connection with *Heliopetes laviana, S. pulverulenta* displays regular larval habits at least on *Abutilon abutiloides.*

Bexar Co.: 27 November 1960. Numerous larvae were observed on *W. holosericea* and *A. wrightii* growing in the laboratory garden in San Antonio. Ten days later, following near freezing temperatures, a cursory examination disclosed no larval shelters. On 18 December careful examination revealed the larvae in leaves beneath these plants. It was most interesting that only those leaves which had been partially eaten or otherwise damaged had fallen following the cold temperatures. Each larva regularly ate from the edge of the leaf and then returned to its shelter on the same leaf. Forty-four were found. They were placed inside a screened cage and left outdoors all winter. Periodic examinations were made to determine pupation dates. The first larva pupated 23 February 1961. Adults emerged following diapause: 4 Mar. (2), 9 Mar. (5), 12 Mar. (1), 13 Mar. (2), 14 Mar. (2), 15 Mar. (1), 16 Mar. (5), 17 Mar. (6), 18 Mar. (1), 22 Mar. (5), 24 Mar. (2), 25 Mar. (1), 27 Mar. (2) (plus 3 parasities), and 13 Apr. (1). Twenty-three of these fed on *W. holosericea* the other 13 on *A. wrightii.* On 15 April a pupa was found in nature representing the spring brood. It is conceivable that adults from the first spring brood actually emerged before the last of the overwintering brood.

Cameron Co.: 24 October 1960. At the U.S.D.A. Research Center in Brownsville, a spot check was made of various species of malvaceous plants growing in an experimental garden. One larva of *S. pulverulenta* was found on *Sphaeralcea angustifolia.* Larva pupated 13 November and a male emerged 28 November 1960. At the Laguna–Atascosa National Wildlife Refuge two larvae were found 21 April 1962 on *W. amplissima.* One larva died, the other pupated 5 May, and a female emerged 14 May 1962.

Live Oak Co.: 22 October 1960. Near Oakville one larva was collected on *A. wrightii.* It pupated 12 November and a male emerged 26 November.

McCulloch Co.: 14 August 1961. At a roadside park on U. S. Highway 377 which marks the geographical center of the State, three larvae were found on *W. holosericea.* Larvae pupated in due course and adults emerged 13, 23, & 26 September; all were males.

Refugio Co.: 15 October 1963. On Farm Road 136 between Bayside and Woodsboro, one larva was found on *W. holosericea.* It pupated 8 November and a female emerged 20 November.

San Patricio Co.: 21 August 1960. At Lake Corpus Christi State Park near Mathis, two larvae were collected on *A. abutiloides.* A return visit on 11 September yielded more than 60 larvae and 10 pupae on this mallow. Some of these were kept under laboratory conditions; others were placed on unprotected malvaceous plants in the laboratory garden. In the controlled environment, adults emerged from field-collected pupae: 10 Sept. (1), 13 Sept. (2), 14 Sept. (2), 16 Sept. (1), 18 Sept. (1), 19 Sept. (1), 20 Sept. (1); from field-collected larvae: 22 Sept. (2), 23 Sept. (3), 24 Sept. (2), 26 Sept. (2), 27 Sept. (1), 2 Oct. (2), 3 Oct. (1), 5 Oct. (1), 7 Oct. (2), 8 Oct. (2), 13 Oct. (1), 16 Oct. (1), and 19 Oct. (1). A third visit to the park on 7 October 1961 yielded two larvae on *W. amplissima.* Both these larvae pupated 27 October with a male emerging 11 November and a female 13 November. At the Welder Wildlife Refuge near Sinton, one larva was found 11 November 1962 on *A. incanum* and twelve on *W. holosericea.* Four more were collected 20 November at the same location on the last named plant. All 17 of these larvae entered diapause. Adults emerged following diapause: 1 Apr. (1♂), 2 Apr. (1♀), 3 Apr. (1♂, 1♀), 4 Apr. (1♀), 5 Apr. (1♂, 1♀), 8 Apr. (2♂♂), 9 Apr. (4♂♂, 1♀), 10 Apr. (1♀), 13 Apr. (1♀), 22 Apr. (1♀). It was noted that these adults emerged about one month later than those from other previously observed overwintering immatures. This was attributed to adverse climatic conditions.

The writer has collected this species in three other Texas counties as

follows: Comal (21 June 1959, 9 Aug. 1959, 6 Aug. 1960, and 27 July 1963); Val Verde (30 Apr. 1961); Zavala (18 Aug. 1963).

Staphylus mazans (Reakirt).[4] This skipper, the mazans sooty wing has been recorded every month of the year in extreme southern Texas (Freeman, 1951). In the more northern parts of its range, it may be found from March to November where perhaps three broods occur. A larval or pupal diapause is indicated. An aborted diapause in a few individuals might account for the flight of *mazans*, sparingly at times, throughout the year in certain localities. Three of the known larval food plants are annuals; when discovered, perhaps all of them will be. Adult hibernation is remotely possible. In any event, further research is necessary to establish the perpetuation factors for *mazans*. The three larval food plants, recorded for the first time, are: *Amaranthus retroflexus* L., *Chenopodium album* L., and *Chenopodium ambrosioides* L. Doubtless other related plants are equally acceptable.

Bexar Co.: 26 June 1960. In Olmos Park at San Antonio, five larvae were found on *C. album*. They were reared through on this plant. Larvae build protective shelters by pulling leaves together which are enlarged to compensate for growth and pupation. Pupal duration was eight days for three observed examples. Adults emerged: 10 July (1♀), 19 July (1♂), 21 July (1♀), 23 July (1♂), and 25 July (1♀).

Comal Co.: 6 August 1960. Along the Guadalupe River, NW of New Braunfels, a female was collected and confined over *C. album*. A quantity of eggs were deposited, and these started hatching 13 August. On 25 August all larvae were lost due to development of fungus; a living plant was not used.

Guadalupe Co.: 7 July 1962. At a roadside park on U. S. Highway 90, three miles E of Kingsbury, two larvae were found on *Amaranthus retroflexus* L. They were reared through on this plant. A female emerged 22 July and another female 4 August. One *Pholisora catullus* (Fabricius) larva shared this host plant with *mazans*.

San Patricio Co.: 25 April 1962. At the Welder Wildlife Foundation Refuge, one larva was collected on *C. ambrosioides*. It pupated 29 April and a male emerged 8 May.

The writer has collected *mazans* in nine other Texas counties from Kimble, Comal, and Bastrop southward.

Cogia hippalus outis (Skinner). The outis skipper is widespread but quite local in Texas. Further research will probably disclose that it inhabits most if not all of the area where its larval food plant is found. Due to considerable overlapping, the exact number of broods is unknown. It is believed that the number varies from three to five depending upon the climatic conditions of a given season, with four as the usual number.

In the Olmos Park Bird Sanctuary, San Antonio, fresh adults were found quite common around a large colony of *Acacia angustissima*

[4] Determination verified by H. A. Freeman.

(Mill.) Kuntze var. *hirta* (Nutt. ex Torr. & Gray) Robinson. After a few minutes, it was observed that these individuals were not only feeding on the blossoms but also ovipositing on the under surface of terminal leaves of this plant. Over a period of four years the writer had collected only six examples of *outis*; at Olmos Park more than 20 were taken within an hour. Many more could have been collected.

Bexar Co.: 1 July 1961. At Olmos Park four females were taken alive for laboratory experimentation. One of these had been observed to oviposit in nature; and it was the only one to oviposit in captivity. Forty-six ova were deposited 3–4 July. Seven more egg-laying females were observed in nature 16 July, three of which were collected. Only one of these deposited additional eggs in the laboratory.

The rearing of *outis* from Bexar County over a period of three years is summarized as follows. *Immatures collected in nature.* Eggs in 1961: 1 July (3), 2 July (4), 16 July (2), and 20 Aug. (1); in 1962: 22 July (9). Ovipositing females observed in 1961: 1 July (1), 16 July (3); in 1962: 27 May (3); in 1963: 3 July (1), and 25 July (1). Larvae in 1961: 11 July (2), 15 July (9), 16 July (46), 20 Aug. (12), 20 Sept. (7); in 1962: 27 May (10), 26 June (2), 12 July (4), 8 Aug. (8), 12–14 Oct. (12); in 1963: 8 May (9), 30 May (14), and 5 Aug. (12). *Emergence of adults.* From field-collected larvae in 1961: 23 July (1), 24 July (1), 2–8 Aug. (10), 12–18 Aug. (18), and 20 Aug. (2). Following larval diapause in 1962: 26 Mar. (1), 30 Mar. (1), 6 Apr. (1), 11 Apr. (1), 22 Apr. (2), and from spring 1962 brood; 13–19 June (10). From larval diapause in 1963: 27–29 Mar. (3) and 4 May (1). From spring 1963 brood: 28 May (1), 1–6 June (7), 10 July (1), 1–2 Aug. (3), 19 Aug. (1), 22–27 Aug. (8), and 20 Sept. (1). Reared from eggs in 1961: 4–5 Aug. (4), 11–15 Aug. (9), 17–18 Aug. (3), and 21–23 Aug. (2).

Bastrop Co.: 2 September 1961. At a roadside park on Texas Highway 21 about 5.5 miles NE of Bastrop, a female was observed to oviposit on *A. hirta*. The insect eluded capture, but the egg was recovered. The first instar larva hatched in due course, but fungus later killed it.

Caldwell Co.: 19 May 1962. On Farm Road 20 just NE of Farm Road 1854 junction, 42 larvae were collected on *A. hirta*. Larvae started pupating 26 May and continued to do so at a rate of a few each day until all except seven had pupated; five larvae and two pupae were preserved. Two larvae appeared to enter diapause but later died. Adults emerged: 3 June (1♂), 5 June (1♂), 6 June (1♂), 7 June (1♂, 4♀♀), 8 June (2♂♂, 4♀♀), 9 June (2♀♀), 10 June (1♂, 2♀♀), 11 June (2♂♂), 12 June (1♀), 13 June (1♂, 4♀♀), 14 June (1♂, 2♀♀), 15 June (1♂, 2♀♀), and 16 June (1♂, 1♀) for a total of 13♂♂, 20♀♀.

Cottle Co.: 13 August 1961. At a point on U. S. Highway 83 between Paducah and the Pease River 35 larvae were found on a small patch of *A. hirta* which was growing in a fencerow. Seventeen of the larvae later proved to be host to five species of parasites, one of which was undescribed and is being studied by Miss L. M. Walkley of the U. S. National Museum. The remaining 13 larvae went into diapause, but one died before pupation. Larvae were left outdoors where they had spun shelters on the ground under debris. Examination 25 March 1962 disclosed larvae still in diapause. They were next examined 30 March and found all pupated. Adults (7♂♂, 5♀♀) emerged: 15 Apr. (1♂, 2♀♀), 16 Apr. (2♂♂, 1♀), 17 Apr. (1♂, 1♀), 19 Apr. (1♂, 1♀), 20 Apr. (1♂), and 21 Apr. (1♂).

Kinney Co.: 17 August 1963. At the railroad and dirt farm road crossing of Pinto Creek, two last instar larvae were found in a small clump of *Acacia texensis* Torr. & Gray. Several abandoned larval shelters were present suggesting that larvae

had sought places on the ground to pupate. Both larvae pupated 23 August and males emerged 1 & 2 September.

LARVAL HABITS. Newly hatched larvae construct their shelters by pulling together, beneath the leaf, two leaflets of the compound leaf. Later, as the larva grows, it enlarges the shelter so that all the leaflets may be pulled together below the petiole. With this configuration the shelter is not very conspicuous to the untrained eye. When the larva is fully mature it seeks shelter on the ground under leaves or debris. When fallen leaves or other material was not available, caged larvae actually burrowed under the soil surface for protection during diapause and pupation. The shallow earthen chamber was silk lined, which provided anchorage for cremaster hooks and a smooth surface for the tender pupa.

Thorybes bathyllus (Smith). The southern cloudy, or dusky wing has been collected in Texas during April, May, July, and September. Reared specimens have emerged in March, April, June, October, November, and December. Careful collecting in the right spots should reveal *bathyllus* flying, in limited numbers, from March to December. The writer has knowledge of only five Texas county locations. Immatures have been collected in nature on *Astragalus engelmannii* (Sheldon) Jones, *Centrosema virginanum* (L.) Benth., *Desmodium ciliare* (Muhl.) DC., *Desmodium paniculatum* (L.) DC., *Lespedeza hirta* (L.) Hornem., and in the laboratory reared on *Lespedeza texana* Britt.

Bastrop Co.: 5 September 1961. At Bastrop State Park, four larvae and one egg were found on *L. hirta*. One larva was preserved, the others reared through on *L. texana* with adults emerging: 29 Oct. (1 ♀), 6 Dec. (1 ♂), and 10 Apr. 1962 (1 ♀). The egg collected 5 September hatched the same day; its larva pupated 29 October and a female emerged 26 November.

Another visit to the park 19 May 1962 yielded five larvae; two on *A. engelmannii* and three on *D. ciliare*. Two larvae which were thought to be in diapause died. The remaining three were reared through on *L. texana*. Adults emerged: 17 June (1 ♀), 18 June (1 ♀), and 19 June (1 ♂). The exact pupation date was observed for only one, and it remained in the pupal stage 12 days.

At Buescher State Park, 25 August 1962, one last instar larva was collected on *C. virginanum*. It pupated 4 September and a female emerged 15 September.

Brazoria Co.: 15 April 1962. On the San Bernard River at Churchill Bridge, one larva was collected on *D. paniculatum*. It pupated 23 May and a female emerged 4 June. Freeman (1951) also recorded *bathyllus* from this county.

Smith Co.: 1 September 1963. At Tyler State Park, one larva was collected on *D. paniculatum*. It pupated 5 October and a male emerged 19 October. Freeman also (1951) recorded *bathyllus* from this county.

Walker Co.: 2 September 1961. At Huntsville State Park, three larvae and one egg were found on *C. virginianum*, but the egg was lost. Larvae were reared through on *D. ciliare*. Adults emerged: 13 Oct. (1 ♂), 20 Oct. (1 ♂), 26 Oct. (1 ♀), and 23 Mar. 1962 following larval diapause (1 ♂).

Roy W. Quillin collected one female at San Antonio, Bexar Co., on 5 April 1959. The writer examined this specimen and found it to be

in excellent condition. It appears that this is the only county record for *bathyllus*.

Thorybes pylades (Scudder). The northern cloudy wing may be found in all major botanical areas of Texas except the South Plains. It flies from March to November. In central Texas, March, April, June, and September are the best months to find it. Laboratory studies indicate a semilarval summer diapause. Three to four broods may be expected under favorable climatic conditions.

Kendall (1959) gave *Rhynchosia* (*Dolicholus*) *texana* Torr. & Gray as a larval food plant for *pylades* in his chart of larval food plants but failed to include life history data in the text. These data are now given together with two additional larval food plants: *Astragalus nuttallianus* DC. and *Desmodium paniculatum* (L.) DC.

Bandera Co.: 2 April 1959. On Park Road 37 to Medina Lake, a female was collected while ovipositing on *R. texana*. Four eggs were found in nature and the captive female deposited 17 more in the laboratory. Ova started hatching 15 April. The first larva pupated 23 May. Four males and nine females emerged: 4 June (1♂), 5 June (1♀), 15 June (1♀), 16 June (1♀), 18 June (2♀♀), 20 June (1♂), 21 June (1♀), 22 June (1♂, 1♀), 24 June (1♂), 29 June (1♀), and 8 July (1♀). Immatures were preserved. Young larvae hide between leaves pulled together; older larvae hide under debris on the ground.

Bastrop Co.: 19 May 1962. At Bastrop State Park one last instar larva was found on *A. nuttallianus*. It pupated in due course and a female emerged 28 June 1962. At the same location on 30 March 1963 a female was observed to oviposit on *D. paniculatum*.

Bexar Co.: 12 April 1959. Northwest of San Antonio near the intersection of Culebra Road and Loop 410, several eggs were collected on *R. texana* along with two egg-laying females. All eggs were preserved. On 26 April at another location north of the city, one larva and four ova were found on *R. texana*; these were preserved. Two years later at still another location near San Antonio, a pair were taken *in copula* about 11:00 A.M. CST, 8 April 1961. The female was kept for eggs but none were deposited. A return visit to the spot on 16 April yielded one egg-laying female, 14 ova, and seven first instar larvae on *R. texana*. The larvae collected in nature were preserved. In the laboratory, this female deposited 15 more eggs. Ova hatched shortly and the first larva pupated 24 May. Eight males and five females emerged: 3 June (1♂), 5 June (1♀), 11 June (1♀), 12 June (1♂), 14 June (1♂), 19 June (1♂), 20 June (1♂), 23 June (1♂), 28 June (1♀), 29 June (1♂), 30 June (1♀), 6 July (1♀), and 8 July (1♂). On another visit to the site, 6 October 1963, a female was taken while ovipositing on *R. texana*. The laboratory environment failed to stimulate further oviposition.

Blanco Co.: 3 May 1963. On U. S. Highway 281 at the Little Blanco River, one first instar larva was collected on *R. texana*. Larva matured in due course but failed to pupate due to parasitism. An ichneumonid larva appeared 14 June, and the adult parasite emerged 25 June 1963.

Kerr Co.: 24 May 1959. At Kerrville State Park, one first instar larva was found on *R. texana*.

Medina Co.: 24 April 1960. At Medina Lake, an egg-laying female was collected; five eggs were deposited immediately after capture on *R. texana* held in a butterfly net. The eggs were preserved.

Thorybes pylades albosuffusa Freeman.[5] This "form" seems to be geographically restricted, to Brewster and Jeff Davis counties, where it has been collected from April to August.

Jeff Davis Co.: 2 May 1961. On Texas Highway 118 below McDonald Observatory in the Davis Mountains, this skipper was found visiting flowers and ovipositing on *Rhynchosia* (*Dolicholus*) *texana* Torr. & Gray. A number of ova, larvae, and adults including one egg-laying female were collected. The female deposited more than 20 eggs on *R. texana* while in transit to the laboratory. A series of all immature stages was preserved. Adults emerged: 11 June (2♂♂), 13 June (1♂), 14 June (2♀♀), 16 June (1♂), 20 June (1♂, 2♀♀), 22 June (1♀), 25 June (2♂♂), 27 June (1♀), 29 June (1♂), and 8 July 1961 (1♀).

Achalarus lyciades (Geyer). The hoary edge is not well known in Texas, but it is fairly common at times in certain localities. It has been collected from April to September; laboratory rearings indicate a few may emerge, under favorable conditions, in nature during October, November, and December. Present knowledge limits the distribution in Texas to five counties and the larval food plants to three: *Desmodium ciliare* (Muhl.) DC., *Lespedeza hirta* (L.) Hornem., and *Lespedeza texana* Britt. *ex* Small. For a description of these plants see Turner (1959). A high rate of parasitized immatures is indicated. Klots (1951) states that *lyciades* hibernates as pupa. In Texas, a larval diapause is also established.

Bastrop Co.: 5 September 1961. At Bastrop State Park, one larva was collected on *L. hirta*. It was reared through on *L. texana* in the laboratory. The exact pupation date was not observed, but a male emerged 28 October.

San Jacinto Co.: 14 April 1962. In the Sam Houston National Forest at Double Lake picnic area, several adults were observed sitting in the sun along trails. Although they were too wary to catch, their identity was unmistakable.

Walker Co.: 3 September 1961. At Huntsville State Park, 34 ova were found on *D. ciliare*. All of these proved to be parasitized, and adult parasites emerged from them 8–14 September. One egg-laying female was also collected 3 September. During the following three days it deposited 64 eggs of *D. ciliare* in the laboratory. Eggs started hatching 7 September. Larvae were later reared through on *L. texana*. Some died, and immatures were preserved. Exact pupation dates were not observed. All larvae except one stopped feeding by 31 October; this one stopped feeding 28 November and pupated 30 March 1962. Four had pupated by 19 November and three more between 11 February and 8 March; two others were unobserved. Four larvae in diapause died. Six males and four females emerged: 16 Nov. (1♂), 19 Nov. (1♀), 22 Nov. (1♀), 4 Dec. (2♂♂), 3 Apr. (1♀), 6 Apr. (1♂), 10 Apr. (1♂), and 15 Apr. (1♂, 1♀).

A. lyciades is known from only two other Texas counties. Freeman (1951) collected the species each month from May to September in Dallas County, and Mr. E. M. Kinch reported (*in litt.*) collecting one adult at Benbrook Lake near Fort Worth, Tarrant County, on 4 July 1963.

Achalarus toxeus (Plötz). Except for May and August, the toxeus, or

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[5] Determination by H. A. Freeman.

coyote skipper has been collected in southern Texas each month from February to November. Very little is known of its life history. Three or more broods, and perhaps considerable overlapping of broods, is indicated.

Hidalgo Co.: 19 March 1961. At the Santa Ana National Wildlife Refuge, a female was observed to oviposit on Texas ebony, *Pithecellobium flexicaule* (Benth.) Coulter. The skipper was not captured, but careful examination of twigs from this shrub yielded 12 eggs deposited on leaves, deep in the foliage near the trunk. A few twigs, together with a potted plant from a local nursery, were transported to the laboratory. First instar larvae readily ate the juvenile leaves of this plant. Unfortunately, only a few such leaves were brought to the laboratory and all larvae died before completing the first instar.

It is significant that *toxeus* is well established in areas where *P. flexicaule* is not found. This would indicate that other legumes such as mesquite, *Prosopis glandulosa* Torr., or huisache, *Acacia farnesiana* (L.), may also be acceptable to egg-laying *toxeus* females.

The writer has collected *toxeus* in three other Texas counties: Bexar (1956, month & day not recorded); Live Oak (8 Oct. 1961); San Patricio (10 Sept. 1960, 22 Oct. 1960, 7 Oct. 1961, 2 Sept. 1962, 11 Nov. 1962, 6 July 1963, 15 Sept. 1963, and 12 Oct. 1963). One female collected by Roy W. Quillin 16 September 1961 at San Antonio, Bexar County, was examined by the writer. Freeman (1951) recorded it from San Antonio, Bexar Co., October; McAllen, Hidalgo Co., February; Pharr, Hidalgo Co., March, April, September, October, and November; Corpus Christi, Nueces Co., October; and Laredo, Webb Co., June. Bexar County seems to be its northern limit.

Urbanus proteus Linnæus. The long-tailed skipper has been recorded from only a few counties in Texas. This may be a result of insufficient collecting. *U. proteus* seems to prefer cultivated beans as a larval food plant. It would therefore seem best to look for it around city vegetable gardens. Commercial bean crops may receive insecticides periodically, which, no doubt, would have a bearing on the abundance of *proteus*. It flies from June to December with July, August, and September representing the greatest numbers. Three local larval food plants are: *Phaseolus limensis* Macf., *Phaseolus vulgaris* L., and *Clitoria ternata* L.[6]

Bexar Co.: 19 August 1956. In San Antonio, two larvae were found in leaf nests on lima beans, *P. limensis*. Both larvae pupated 29 August and adults emerged 8 September. On 9 October 1956, an egg-laying female was collected in the laboratory garden. Confined over *P. vulgaris* twigs it deposited numerous eggs which started hatching 14 October. The first larva pupated 4 November. Immatures were preserved and 24 adults emerged from 27 November to 26 December. Again, 13 July 1957, larvae were present on *P. vulgaris* in the laboratory garden. Some were collected for preserving. On 8 August eggs were found and 19 August more larvae

[6] The last named plant determined by Dr. B. L. Turner, University of Texas.

observed. Sixteen eggs were counted on 21 September 1957. Although a few larvae were reared through from time to time, exact emergence dates were not recorded.

Early in 1963, *C. ternata* was planted in the laboratory garden as an ornamental. It was a pleasant surprise to see egg-laying females visit this plant on 9, 11, & 16 June. Soon thereafter larvae were present and feeding on the foliage when not resting in their leaf shelters. They were observed in their unprotected location, but one by one paper wasps (*Polistes*), and perhaps birds, took them.

Chioides catillus albofasciatus (Hewitson). The white-striped long tail is common in the lower Rio Grande Valley of Texas where it has been taken each month of the year. Based on present life history knowledge, an immature diapause is not indicated. It may be found around the edge of wooded areas where its larval food plants grow.

Freeman (1951) collected *albofasciatus* in June at Alpine, Brewster County. André Blanchard (*in litt.*) collected it in Brazoria County 8 & 10 June 1961 and in Harris County 28 September 1957. The writer collected adults in Bexar County 25 & 31 August 1957, 27 April and 14 September 1958, and 22 March 1959. W. A. Pluemer, formerly of San Antonio, Texas, collected a badly damaged specimen 11 October 1959 at Helotes also in Bexar County; no more specimens have been collected or seen in the county since.

Comstock & Garcia (1961) found larvae in Mexico feeding on *Tephrosia* sp. They also illustrate the mature larva and pupa. Three larval food plants from Texas are here recorded: *Phaseolus atropurpureus* DC., *Rhynchosia minima* (L.) DC., and *Tephrosia lindheimeri* (Gray) Kuntze (all Leguminosae).

Cameron Co.: 18 October 1963. Along a railroad in NW Brownsville, adults were found flying in good numbers. While the writer searched for immatures, his companions, Mrs. Kendall and Dr. J. W. Tilden, collected adults. A female was observed to oviposit on *P. atropurpureus* growing in a fencerow. After netting the insect, examination disclosed several larvae in leaf nests on the plant. Larvae were also found on *R. minima* nearby. Of 19 larvae collected, 13 were preserved. Pupation of the others occurred from 23 October to 7 November except for two which died. Adults emerged: 8 Nov. (1 ♀), 18 Nov. (1 ♂), 20 Nov. (1 ♂), and 26 Dec. (1 ♂).

Two gravid females collected 18 October deposited 236 ova on *R. minima* and *P. atropurpureus* from 20–30 October. Eggs started hatching within a few days and larvae fed until a freeze killed the food plant in mid-December. Seven larvae had matured enough to pupate by 1 January 1964, five more by 16 January, two more by 18 January, and one 22 January. All the remaining larvae appeared to be in various stages of malnutrition and were preserved. Three of the pupae were provided for chromosome counts. Of the remainder, some were kept in the laboratory, others left outdoors. None survived.

In their natural habitat, larval growth would no doubt have been retarded by lowered nonfreezing temperatures, with feeding possibly taking place on warm days when local temperature exceeded 60° F. The length of the pupal period would also be influenced by temperature. In this way a few could emerge from time to time, with the main flight following in mid-March.

A return visit to the county 29 March 1964 found adults flying on Padre Island near Port Isabel and elsewhere. Larvae and eggs were found on *R. minima.* Eight larvae were collected, and pupation occurred from 25 April to 4 May. Adults

emerged: 10 May (1♂), 12 May (1♂), 13 May (1♀), 14 May (1♂), 15 May (1♂), 17 May (2♀♀), and 18 May (1♀).

Hidalgo Co.: 23 October 1960. On U. S. Highway 281 near San Manuel, one larva was found in a leaf nest on *T. lindheimeri*. Another larva was found the following day in the same general area on this plant. Sufficient food plant was kept under refrigeration to rear them through. One larva stopped feeding 4 November, pupated 7 November, and a male emerged 28 November. The other larva stopped feeding 6 November, pupated 8 November, and a male emerged 29 November 1960.

Jackson Co.: 4 June 1961. Mr. & Mrs. André Blanchard took the writer and Mrs. Kendall to one of their favorite collecting spots on Carancahua Creek near the village of Francitas. A female *albofasciatus* was observed to oviposit on *R. minima* which was abundant in the area. The female deposited 41 eggs under laboratory conditions and two which were recovered in the field. Eggs are deposited on the underside of terminal leaves. Hatching started 7 June. Twenty-one larvae pupated between 4–10 July. Twelve males and six females emerged: 13 July (1♂), 15 July (5♂♂), 16 July (2♂♂), 17 July (1♂, 1♀), 18 July (1♂, 1♀), 19 July (1♂, 1♀), 20 July (1♂), and 21 July (3♀♀). Representative specimens of the life history were preserved.

Epargyreus clarus clarus (Cramer). The silver spotted skipper is at times common in Texas, in certain locations around its larval food plants. The species flies from March to September, with June, July, and August the best months to find it. This skipper is well adapted to metropolitan living because several of its most acceptable larval food plants are grown as ornamentals. Two larval food plants are known from Texas: *Wisteria sinensis* (Sims) Sweet and *Robinia pseudo-acacia* L. Wild females have been observed to oviposit on *Erythrina herbacea* L. and *Rhynchosia minima* (L.) DC. in nature, but the larvae will not eat these plants.

Bexar Co.: Because this insect is so common in the laboratory garden at San Antonio, little attention has been given to rearing it. Although it has been reared and its life history preserved, few emergence records have been made. It is significant to record dates on which females have been observed to oviposit on *W. sinensis* in the laboratory garden: 17 June 1956, 14 June 1958, 15 Apr. and 18 Sept. 1960, 2 July 1962, and 25 May 1963. Larvae have been observed: 8 June and 14 July 1958, 24 Oct. 1959, 14 & 28 May and 1 Oct. 1960, 26 Aug. 1961, 21 July 1962, 2 July and 4 Aug. 1963. The greatest number of adults seen at one time was 13, 1 July 1962, feeding on blossoms of buttonbush, *Cephalanthus occidentalis* L.

On 16 July 1960 Roy W. Quillin of San Antonio reported seeing females oviposit on *E. herbacea* which grows as an ornamental in his yard. An examination of this plant disclosed a number of eggs of *clarus* on the leaves; some were collected and taken to the laboratory for study. First instar larvae would not sample the leaves of this plant.

In the laboratory garden, females were observed to oviposit on *Rhynchosia minima*, 10 July, 13 July, and 7 September 1963. Numerous ova were to be found on the foliage of this plant. First instar larvae would notch the leaf and fashion a shelter, but then die. A few would venture out for one or two more feedings. Apparently this plant is toxic to *clarus* larvae.

Smith Co.: 3 September 1960. Near Tyler, five larvae were found on *R. pseudo-acacia*. They pupated in due course but died before 1 February 1961 due to dehydration. For best results, pupae of *clarus* should be left outdoors, on the ground in their leaf nests. Adults emerge in March from pupal diapause.

CHART OF LARVAL FOOD PLANTS

Plant Family	Plant Species	Lepidoptera
Amaranthaceæ	*Amaranthus caudatus*	*Pholisora catullus*
	Amaranthus retroflexus	*Pholisora catullus*
		Staphylus mazans
	Amaranthus spinosus	*Pholisora catullus*
Cannaceæ	*Canna indica*	*Calpodes ethlius*
Chenopodiaceæ	*Chenopodium album*	*Pholisora catullus*
		Staphylus mazans
	Chenopodium ambrosioides	*Pholisora catullus*
		Staphylus mazans
	Chenopodium berlandieri	*Pholisora catullus*
Fagaceæ	*Quercus fusiformis*	*Erynnis horatius*
	Quercus gambelii	*Erynnis horatius*
	Quercus hemisphaerica	*Erynnis horatius*
	Quercus laurifolia	*Erynnis horatius*
	Quercus marilandica	*Erynnis horatius*
	Quercus nigra	*Erynnis horatius*
	Quercus phellos	*Erynnis horatius*
	Quercus shumardii	*Erynnis horatius*
	Quercus stellata	*Erynnis horatius*
	Quercus texana	*Erynnis horatius*
	Quercus virginiana	*Erynnis horatius*
Gramineæ	*Cynodon dactylon*	*Amblyscirtes vialis*
		Copæodes aurantiaca
		Hesperia viridis
		Polites v. præceps
	Lolium perenne	*Hesperia viridis*
	Stenotaphrum secundatum	*Polites v. præceps*
Leguminosæ	*Acacia hirta*	*Cogia h. outis*
	Acacia texensis	*Cogia h. outis*
	Astragalus engelmannii	*Thorybes bathyllus*
	Astragalus nuttallianus	*Thorybes pylades*
	Baptisia laevicaulis	*Erynnis baptisiæ*
	Baptisia tinctoria	*Erynnis baptisiæ*
	Centrosema virginanum	*Thorybes bathyllus*
	Clitoria ternata	*Urbanus proteus*
	Desmodium ciliare	*Achalarus lyciades*
		Thorybes bathyllus
	Desmodium paniculatum	*Thorybes bathyllus*
		Thorybes pylades
	Indigofera lindheimeriana	*Gesta g. invisus*
	Indigofera suffruticosa	*Gesta g. invisus*
	Lespedeza hirta	*Achalarus lyciades*
		Thorybes bathyllus
	Lespedeza texana	*Achalarus lyciades*
		Thorybes bathyllus
	Phaseolus atropurpureus	*Chioides c. albofasciatus*
	Phaseolus limensis	*Urbanus proteus*
	Phaseolus vulgaris	*Urbanus proteus*
	Pithecellobium flexicaule	*Achalarus toxeus*
	Rhynchosia minima	*Chioides c. albofasciatus*

CHART OF LARVAL FOOD PLANTS (Continued)

Plant Family	Plant Species	Lepidoptera
	Rhynchosia texana	*Thorybes pylades*
Leguminosæ	*Robinia pseudo-acacia*	*Epargyreus c. clarus*
	Tephrosia lindheimeri	*Chioides c. albofasciatus*
	Wisteria sinensis	*Epargyreus c. clarus*
Malvaceæ	*Abutilon abutiloides*	*Heliopetes laviana*
		Systasea pulverulenta
	Abutilon incanum	*Celotes nessus*
		Heliopetes laviana
		Systasea pulverulenta
	Abutilon wrightii	*Systasea pulverulenta*
	Althaea rosea	*Celotes nessus*
		Pyrgus c. communis
	Callirhoe leiocarpa	*Pyrgus c. communis*
	Malvastrum americanum	*Heliopetes laviana*
	Malvaviscus drummondii	*Heliopetes macaira*
	Sida filicaulis	*Pyrgus c. communis*
	Sida filipes	*Celotes nessus*
		Heliopetes laviana
	Sida lindheimeri	*Pyrgus c. communis*
	Sida rhombifolia	*Pyrgus c. communis*
	Sphaeralcea angustifolia	*Pyrgus c. communis*
		Systasea pulverulenta
	Sphaeralcea cuspidata	*Pyrgus c. communis*
	Sphaeralcea lindheimeri	*Pyrgus c. communis*
	Sphaeralcea lobata	*Celotes nessus*
	Wissadula amplissima	*Celotes nessus*
		Systasea pulverulenta
	Wissadula holosericea	*Heliopetes laviana*
		Systasea pulverulenta
Rutaceæ	*Zanthoxylum fagara*	*Achlyodes t. tamenund*

Other Texas counties in which the writer has collected *clarus* are: Comal, 21 July 1963; Polk, 14 April 1962. Mr. André Blanchard (*in litt.*) reports collecting it 10 June 1961 in Brazoria County. Here its larval food plant could be *Gleditsia triacanthos* L.

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STATUS OF *AGRAULIS VANILLAE* IN MISSOURI AND KANSAS

The recent article (Jour. Lepid. Soc., 17: 227–228, 1964) by Richard D. Turner regarding *Agraulis vanillae* (L.) in Missouri was of interest. Its author arrived at the conclusion that simply because *vanillae* happened to be quite abundant on *Passiflora* at Green Ridge, Missouri, for several successive summers that the butterfly had successfully survived the winter in the area. Unfortunately this is a conclusion reached by the author who overlooked the fact that *A. vanillae* is a migratory species in both Missouri and Kansas. Females traveling from much farther south (the Gulf or the tropics?) reach this latitude in sporadic numbers during June and July. Since *Passiflora* does come up from the roots in this area by late spring, a wandering female, if she happens to be passing through the area and accidentally locates such a vine, will indeed cover its leaves with eggs. Caterpillars are subsequently pro-

duced and pupae formed, all of which takes place in rapid succession. A pupa may develop into an adult in only six days.

Ottawa, Kansas, and Green Ridge, Missouri, are of nearly identical latitude and only a hundred miles apart so the situation should be rather similar. Last summer (1963) was one of particularly heavy migration of *A. vanillae* in wide sections of both Kansas and Missouri. One vine in Ottawa was literally covered with the caterpillars of *vanillae.* Another vine in a different section of town had not a single caterpillar on its leaves. The latter vine simply had not been discovered by a roving migrant female. By autumn, however, enough progeny had been produced from the first vines to spread out and seek out all available host plants of the area. By September the adults were quite abundant in much of the area and especially in the towns. In two months I had easily reared over 200 caterpillars (not one was parasitized!), and as many as twelve butterflies emerged from pupae in a single day. But the day of reckoning came during the last week in October. Every single chrysalid that had not emerged before 29 October never emerged. All 37 of them were hanging limp and lifeless in their screen cage. They all perished during one freezing night.

We have in Kansas and Missouri three principal types of butterflies: breeding residents, breeding migrants, and (usually tropical) wind-blown strays. *Agraulis vanillae* is distinctly of the middle group. *Colias* (*Zerene*) *cesonia* (Stoll) is quite possibly another such butterfly, though strong evidence supports the idea that at least a few adults of *cesonia* hibernate here as well. The tropical blue, *Leptotes marina* (Reakirt) sometimes migrates here too, temporarily establishes a local colony, but is completely wiped out with the first hard freeze. This is exactly what happens to *vanillae*; it cannot withstand the severe cold that occurs every winter in every section of both Missouri and Kansas, and this applies to each of its four life stages. An adult *vanillae* cannot withstand winter hibernation nor does it make any attempt to do so as does another native subtropical nymphalid, *Anaea andria* Scudder. This explains why adult *vanillae* are never seen here very early in spring. It is usually at least June before migrating adults can reach this latitude from farther south. Some seasons they do not reach us at all and then we have no *vanillae* that year, since no colonies can exist here without an influx of females to propagate themselves. Whether or not this situation prevails in northern California I cannot say, but I can state positively that this is the situation that prevails regarding *Agraulis vanillae* within the boundaries of both Kansas and Missouri.

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OSCAR THEODOR BARON (1847–1926)[1]

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In trying to restrict the type locality of *Cercyonis baroni* Edwards to a more particular place than Mendocino County, California, I searched the literature for information about O. T. Baron. Neither in the very brief mention by Essig (1931: 552) nor in the only other article noted by Carpenter (1953: 263), O. Meissner's obituary of Baron (1929: 131), could I find any details of Baron's travels in California. This led me to search for primary material, letters from Baron to his associates. There is no letter in the limited amount of W. H. Edwards' correspondence preserved in the archives of the State of West Virginia in Charleston, W. Va. There are 74 items in the Strecker correspondence housed in the department of entomology, Chicago Natural History Museum. Twenty-six items in the Henry Edwards correspondence are in the library of the American Museum of Natural History in New York. Koebele's letter-book in the archives of the Pacific Coast Entomological Society stored at the California Academy of Sciences contains fifteen items. From these letters and postcards, over a hundred in number, I have been able to bring together a considerable body of information that may be of use to others.

Oscar Theodor Baron was born on September 9, 1847, in Repsch, East Schleswig, Germany. He was the son of a schoolmaster. According to his sister, Baron started collecting insects at the early age of 13 years while a student at the Gymnasium in Neustadt. As a young man he shipped as a sailor to the Orient and visited India, China, and the Indo-Australian islands. He was shipwrecked on Java, where he contracted scurvy. From there he shipped to the west coast of America. His first job in the New World was as a surveyor. He mapped a small island off the coast. On it he collected little-known beetles that were deposited with the California Academy of Sciences in San Francisco. This much I learned from Meissner's account. The name of the island is lost.

The Henry Edwards Correspondence

The earliest Baron letters that I have read are in the Henry Edwards correspondence. The first one is dated "Navarro. Apr. 18th 76." At that time Baron was 28 years old and worked at loading schooners plying between a small mill in Navarro, Mendocino County, and San Francisco.

[1] This study was in part supported by N.S.F. Grant GB-194.

In his spare time he collected moths, butterflies, and other insects. He also made some botanical collections. Baron considered Navarro his home until the end of the summer of 1879, when he moved to Mendocino, another small coastal town. It is apparent from the text of this first letter that Baron and Henry Edwards had exchanged previous correspondence. The second letter preserved from 1876 is dated from Mendocino, December 15th. In it Baron noted "I find that the Saturnia and the P. Ceanothy [sic!] feed also on Arctostaphylos. . . ."

There are four letters written in 1877 from Navarro. There is every indication in these that he was so busy that he had little time for collecting. He continued to raise saturnids and other moths from larvae and eggs collected locally. Apparently Baron had lived for a year or so in Mendocino before moving to Navarro in 1876. The four letters are dated 7 April, 9 July, 6 August, and 9 November, respectively.

Only two items are preserved from 1878, a letter dated 3 March and a postcard dated 27 March. On the latter Baron noted "I have received the Butterflies from Mr. W. H. Edwards, sent to you for me. Thanks to the careful packing they arrived in excellent condition, not one antennae being broken." In W. H. Edwards' manuscript Journal "F" for 1876 there is this note on p. 240 "Oscar T. Baron, Mendocino Mill, Mend°. Cal^a. change to Navarro Mills." On pp. 237–238 in Journal "G" Edwards noted that he had received "about 2 dozen [chrysalids of Mel. Baroni] from Baron May 18, 1879." I could find no account in Edwards' Journals of the butterflies he sent to Baron. Probably they were material that had been submitted for determination.

The year 1879 produced a long array of letters, sixteen in all. Baron continued to live in Navarro until April when he set out on a collecting trip, the first real one that he made. He announced this in a letter of 14 March, "Things with me are very disagreeable and I intend to leave Navarro very soon, and shall spend the summer traveling in California, and, of course, collect as I go along. I intend to do some hard work. My plan is to get a horse and a very light wagon and start about Apr. 15th, when the roads begin to get into order again, and travel through Mendocino and the neighboring counties." This letter also announced to Henry Edwards that a box containing about 300 specimens was to be shipped to him for sale in the East. Along with the moths, Baron had included "12 Chionobas Iduna ♂ and ♀, some Argynnis & approx. 12 pair Melitaea quino, a few N. menapia, etc." The specimens had been captured during the summer of 1878, probably at no great distance from Navarro. While away on his collecting trip Baron had arranged to have W. G. W. Harford (42 Market Street, San Francisco) act as a mail drop for pack-

ages being shipped from the East. There is a suggestion in the wording of this that Harford was in some way connected with the mills at Mendocino and Navarro.

On 13 April 1879, Baron wrote from Mendocino. Apparently he had started his trek. The next letter is undated but can be placed here by its content. He was at the "Headwaters of Big river, Mendocino, County." By 15 June he had reached "Camp Cache Creek, Lake Co." May had been rainy and Baron had had little success. On 23 May he took a pair of *Papilio indra* on "Mt. St. Hydrian" [Mt. Sanhedrin?—about 20 miles NE of Willits] in Mendocino County. He also wrote that mail would catch up with him at Newville, Tehama County [now Glenn Co.] and that he hoped to ship a box of 1,000 specimens from Red Bluff. A postcard from Red Bluff on 30 June told Edwards that the box had gone off by Wells & Fargo, and "I am going into Trinity Co. next." By 18 August Baron was in Middletown, at the south end of Lake County. He wrote "I have also 4 pairs of Argynnis, a very large species, the ♀ of which is on the upper side deep brown and yellow. I shall also send you a pair of them." Strecker's plate misled Baron and he thought he had taken *nokomis.* W. H. Edwards set him straight on this, his capture had been *leto.* Baron had gotten as far as Trinity County "but had to return on account of rheumatism." He stayed at Middletown until the end of August, then moved on to Calistoga in the northwestern corner of Napa County, from where he sent a postcard on 15 September.

On 24 September Baron wrote from Mendocino "As you see I have returned from my tripp [sic!] and I must say, with tolerable good catch for the season although the weather had been very much against me from the start. Did not get any Chionobas and only seen one ♂. . . . Now I am able to explain why I did not hear so long from you. Mr. W. H. Edwards writes me that you had a serious fall in the White Mountains. I hope, however, that you are well again." The letter of 2 October 1879 opens "Just returned from a weeks tripp [sic!] to the headwaters of Big river. . . ." On the 15th of the month Baron shipped Henry Edwards three boxes of specimens from his summer catch, one for Edwards and the other two to be sold. On the 25th he noted that he had sent a shipment to W. H. Edwards from the summer catch. I could find no reference to these in Edwards' manuscript journals. Among others, Baron shipped specimens to James Bailey, Albany, N. Y., and Graef and Neumoegen in New York City.

There is a letter from Mendocino, dated 27 September without a year date. On content I place it in 1880. In it he told Edwards of plans to go south as far as San Diego in October. He planned again to use horse

and light wagon. There are no letters in the Henry Edwards correspondence to verify the trip but there are in the Strecker correspondence. The last dated letter in the Edwards series was written from "Santa Margarita Cañon, Oct. 23rd 1881" when Baron was working as a location engineer for the California Southern Rail Road Company.

Baron's letter of 7 February 1879, written from Navarro, contains this interesting item: "I have also been successful in preventing moths from getting oily by filled their abdomen with soapstone. Even the Hepiolas [sic!] and Sesiae, so treated, did not turn oily, and I consider the former as one of the insects most difficult to keep without getting oily. It takes pains, but with a case of rare specimens it pays for the trouble." This may be a clue to some Baron specimens.

The Strecker Correspondence

The material in the Strecker collection begins with a letter dated 17 September 1879, from Mendocino. Thus it overlaps a little the Henry Edwards material. The last letter to Strecker is dated 20 January 1893, from San Francisco. During much of the time covered by this correspondence Baron was working in various engineering capacities for one or another of several railroads buildings lines in California and eastward from that State. He had little time for collecting insects, but he did collect some. In the period spanned by the letters Baron made two trips out of the country. In 1885 he was in Mexico and the only letter from this trip is in the Strecker material. In 1889–1891 he was in Ecuador and letters from there are found only in the Koebele correspondence. As did all professional collectors who sold material to Strecker, Baron has his difficulties with Strecker reneging on contracts.

The only thing new that is found in the letters to Strecker written in 1879 is that the *Argynnis leto* specimens had been taken in "Lake Co. Cal during the month of July last." Baron stayed in Mendocino during the winter. On 2 February 1880, he wrote to Strecker "I have sold all specimens I collected last season to Mr. N [Neumoegen] excepting some Catocalae now with Mr. W. H. Edwards for sale . . . I shall start on a collecting trip at the end of this month." On 23 February he set a date for departure, 29 February, with his first objective the town of Ukiah, the county seat. According to a letter of 7 March written from Ukiah he "caught the first specimens of lepidoptera today—Anthocharis reakirty [sic!]." On 28 March he was in Cloverdale, Sonoma County, and stayed in that area at least until 14 May when he wrote "I have collected very little and I am disgusted with the weather we are having. Even yesterday it was raining but looks like a change today. Usually Chionobas

Iduna comes in the end of April and May. I could see now yet traveling 130 miles where they can be found. Of Colias Eurydice I have a few pairs and also 3 specimens of Anth. lanceolata."

From Cloverdale Baron headed north for *iduna*. On 2 July he wrote from Cold Valley (postmarked Glenbrook) "Since I wrote last I succeeded to get 2 promised ♀♀ Chionobas Iduna and one more if you want it and also a nice row of ♂♂. I could not possibly part with the ♂ specimens for less than 75 cents per good specimen and the ♀♀ at $1.00. The expenses has been so much to collect them. . . . Now I am taking some Argynnis Laura and Zerene ♂ & ♀ and hope to find Leto." He also collected some *Colias chrysomelas*, 30 *Hepialus* but only 3 *Melitaea Baroni* and a few male *Papilio indra*. Of the last Baron said "This is a rare species and very hard to get. I traveled on foot in one day 27 miles and climbed about 3500 feet, part of that 3 times and only captured 3 males, one very poor."

By 3 August Baron was in Middletown, Lake County. (The letter is dated from Mendocino but postmarked Middletown. Fortunately Strecker preserved all letters in their envelopes.) In this letter he told Strecker "The Melitaea Baroni I did not get at all this season, all the caterpillars which I collected died and it has been foggy on the coast during my stay there for the butterfly. . . . I did not get the two species of Hesperia which are quite local and found within 2 miles of Mendocino on account of fogg [sic!] while there." A letter dated 28 August 1880 written from Glenbrook, but postmarked Middletown, contained a price list.

By 16 September Baron was at home in Mendocino. From there he dispatched material to Strecker. He also said "I do not think that I shall collect any more this season as it will take me a month of travel to get to Lower [southern] Cal." He left Mendocino some time after 16 October and was at Santa Barbara on 7 November. From there he moved to San Bernardino, writing on the 16th "I have come here, a new field, but do not know how much I will be able to do in Entomology, being offered a position which i [sic!] do not feel justified to reject." This was with a surveying party of the California Southern Rail Road Company.

Apparently Strecker wrote to Baron one of his typical letters belittling all other lepidopterists. On 12 December Baron replied from San Dieguito "After what you have told me about N. [Neumoegen] I shall sent you *all* varieties I may get in the future, not because Mr. N. did not treat me well, far from it, but, as you say, you study Lep. and not take it up as a mere notion. . . . Since my arrival I have seen 4 species of Lepidoptera, much worn, which I never caught before. One of them is,

I think, L. Cythera illustrated in Capt. Wheeler's Reports. The locality is very nice here, a valley surrounded by high mountains, the highest Peak of which is 12,000 feet. A good field for collecting." In a later letter, 8 January 1881, Baron located San Dieguito as being five miles northwest of San Diego. [It sounds as though Baron was in the San Bernardino Mountains, rather than near San Diego.]

During 1881 Baron traveled extensively in southern California and was busy with railroading. He did collect a few specimens here and there. The engineering office for the railroad was in San Bernardino. Baron was there on 9 May. A few days later, 12 May, he was in Santa Margarita Cañon. The letter was posted at San Luis Rey. On 21 June he was at Cajon Pass. A letter sent from San Luis Rey on the 6th of November included "I intend to send you a few things I have collected, among them some very nice things." A few days later from Santa Margarita Cañon he wrote "I shall send you some of the little Lyceana Regia." In December he returned to San Bernardino and joined the engineering crew of another railroad. For them he went to Aptos and wrote on 17 December "I am locating a short piece of road for a broad gage [sic!] RailRoad." He stayed there until the end of January.

1882 was another year of moving about on survey crews. Baron wrote from San Bernardino on the 14th of March "The most of my Catocalae has been caught in Lake Co. but many of them came from Sonoma and Mendocino Counties (the counties join each other.) . . . I have met Mr. W. G. Wright and he told me you correspond with him." From the Mojave Desert he wrote on 7 April "About 3 weeks ago I have seen Mr. Wright of San Bernardino and gave him all information about collecting and preserving Lepidoptera I know and it remains with him if he will succeed or not." Letters in the Wright collection belonging to the Pacific Coast Entomological Society show that he started on his long career as a lepidopterist at this time. Wright had sent butterflies to W. E. Edwards for identification on 8 January 1882.

In June Baron was sent to the San Francisco office of the railroad. On the 7th of the month he complained "This season seems already spoiled for my collecting as I have to stay in the office and work up my notes." On 22 July he was at Duncan's Mills in Sonoma County, apparently on company business. With the cool of the autumn Baron was back on the desert. He wrote from "End of track, Mojave Extention S. P. R. R." on 22 October about *Papilio indra* "I have no specimens and don't know anyone who could get them. I only know Dr. Behr but he is no collector, and has not collected for many years. He is the only man I ever speak German with or drink beer 'Old Style.'"

In February, 1883 Baron was in Mendocino and shipped material to Strecker. At that time he did not know what he would do during the summer. By 16 March he was in Monterey, railroading again. He stayed there into the summer, at least to the end of July. On the 26th of that month he wrote "Please address my letters after the receipt of this to San Francisco, O.T.Baron, California Academy of Sciences, cor. California and Dupont St., San Francisco." Baron had been planning for some years to visit his old home in Germany. On 5 September he wrote from San Francisco "Shall be at Reading [Pennsylvania, Strecker's home] shortly after the 15th the month."

Baron returned from Germany early in 1884. In Germany he had seen Dr. Staudinger and in New York had become acquainted with the people who had been buying his collections. On 12 April he wrote to Strecker using California Academy of Sciences letterhead. He said "I find business in engineering very dull and I shall have to do something outside of that. . . . B. Neumoegen . . . advised me to go to Mexico south of the City of Mexico, saying that very few good specimens have come from that section. . . . My address for the future will be 'O. T. Baron, California Academy of Sciences, P. O. Box 2247, San Francisco, Cal." Baron took to the field in May. He wrote from Baird, Shasta County, on the 1st of June "Shall be in the vicinity of Mt. Shasta for about 10 days. Up to this time I have taken very nice specimens but nothing new. . . . Now I intend to go to Mexico as soon as I return from this collecting trip."

Baron went to Mexico. The only letter that I have seen written by him from there is one from Chilpancingo, Guerrero, dated 10 December 1885. There is nothing in it about Baron's collecting experiences in Mexico. It was written in response to a letter from Strecker who wanted to settle his long outstanding account with Baron for about 35¢ on the dollar. Baron demanded that all of the material he had sent be returned. There is a long hiatus in the correspondence between the two from this point on. It was not until Baron returned from Ecuador in 1891 that the two exchanged letters again.

Koebele's Letter-book

How long Baron remained in Mexico and when he returned to California are questions for which I have found no answers. The source for information about Baron after he returned from Mexico and while he was in Ecuador is the letter-book of Albert Koebele, California's premier economic entomologist, who was a close friend of Baron. Upon his return from Mexico, Baron again turned to railroad engineering for a

living. He managed to do more entomological work along with his railroading than he previously had done. The first evidence of his return is a letter from San Buenaventura in southern California, dated 20 February 1887, in which he counsels Koebele about making up a shipment destined for Berthold Neumoegen, "So far as the shipment of Lepidoptera to B. N. is concerned we can put in from 12 to 20 specimens of a species as he wants duplicates to send somewhere. . . . The commission from this first shipment you can take out of the first money that may come in and take as much as you think fair on both sides." This appears to establish a partnership between Baron and Koebele that continued until Baron had returned from his trip to South America.

Sometime in the winter of 1887–1888 Baron and his crew of engineers set up camp at Pantano, Pima County, Arizona, about 30 miles southeast of Tucson. The first letter from Pantano is dated 28 February 1888. At that time Baron was raising "Sat. Galbini"—*Agapema galbina* Clements—in great numbers. Koebele's father was with Baron at this camp. He probably helped with the rearing. Ultimately Baron shipped over 3,000 cocoons to Koebele. In his letter of 5 June he noted that butterflies were beginning to fly and that he was looking forward to the rains which he hoped would bring out the spring flight. By the 15th of the month—the last letter from Pantano—the camp was coming to a close and Baron was not sure what he would do when that happened. In addition to moths he collected some butterflies and butterfly eggs for W. H. Edwards. Edwards' manuscript Journal for 1888 ("R") notes on p. 33 "June 10 . . . Also 1 or 2 larvae of A. sara from Koebele, Alameda Cal[a]. He sent 43 eggs 4th, but the plant was wilted and only 2 l. to be found." Baron suggested to Koebele that Edwards be charged $5.00 for these eggs. On the 19th of June ("R," pp. 36–37) Edwards made this entry "Rec[d] from O. T. Baron eggs of a new species Neonympha allied to Eurytis at Pantano, Ariz[a]. I once had this species from the Wheeler Expeditions but it was lost by fire in Express car at Washington before I had named or described it. I call this N. Pantano. One larva was out & looked like a young Eurytis." By the 22nd Edwards recognized that the insect was *rubricata* Edwards, now called subspecies *cheneyorum* Chermock. The larvae seemed unable to pass the first molt.

A postcard written 26 July 1888, from Berryville P.O., Siskiyou Co., California announced "I arrived here today and did not stay over at the upper Soda Spring as originally expected. . . . Have probably 25 ♂ & 12 ♀ Argynnis Leto and some other species of Argynnis and a few Satyrus. Cant go to high altitude until next week." On 24 January 1889, Baron wrote to Strecker from Alameda, California, "Have just

returned from Mendocino Co. a few days ago, and at once determined to go to Costa Rica on the steamer of 25th (tomorrow.) Have made arrangements to proceed to Panama if I change my mind and go to S.A. instead."

The next letter preserved was sent to Koebele in Australia and details the difficulty Baron had getting the third lot of *Vedalia cardinalis* (Mulsant) through the Customs Office in San Francisco. In it Baron wrote "Shall leave for Ecuador Febr. 2nd and return—who knows?" This was sent from Alameda on 30 January 1889.

There are seven letters in the Koebele letter-book written from Ecuador. They bear dates running from 24 October 1889 to 11 October 1890. Probably Baron arrived in Guayaquil, Ecuador, early in March, 1889. He did a little collecting on the Pacific Slope but soon after his arrival in the country he moved into the southern part on the Atlantic Slope. His letter of 24 October was written from Loja. He had made two sorties into the Oriente by that time, having just returned from his second trip when he wrote the letter. Just where in the Zamora watershed he had collected on his first trip is not stated. His headquarters on the second was at Zamora. At the time this letter was written Baron had collected between ten and eleven thousand Lepidoptera, four or five thousand beetles, and 700 hummingbirds.

Not all of the letters that Baron wrote from Ecuador are preserved. Some apparently were lost in the mails, others definitely had been received by Koebele but are missing from the letter-book. On the 26th of January, 1890, Baron was on the Rio Pescado. He had arrived there about the middle of the month and planned to stay until the middle of March. His camp was at an elevation of about 2,500 feet. He planned at this time to make two additional trips into the Oriente, one to Sig Sig and the other to Canelos. After his return from the Rio Pescado Baron changed his headquarters to Cuenca from where he wrote on 12 June. In this letter he said "Your letter of March 1st received while on the way from Gualaquiza to Cuenca about 4 weeks ago. I did not get here until a few days ago having remained in the great heights, say 11,000–12,000 feet, 2 days from here." Baron occupied his high camp for three weeks, the last of a seven-week trip. "Gualaquiza is in the hot East and 5 days S.E. from Cuenca and although it is in the same river system of Zamora I got but few Leps during my 14 days stay there."

For his trip to Chimborazo and into the Oriente of the Rio Pastaza Baron made temporary headquarters in Riobamba. He wrote from there on 27 June that the only butterflies he found at high altitude were

"a small Colias, a Pieris [*Tatochila*] and one or two more" and that the moths collected seemed similar to those from California. From a stay of several months' duration in the high mountains in 1938–1939 I can agree with Baron that collecting lepidoptera above 11,000 feet in Ecuador is hard work for few specimens. On 1 July Baron wrote from Riobamba that "Day after tomorrow will go to Baños and below, or where ever I can get butterflies." On 18 September he returned from the Oriente of the Rio Pastaza without getting as far east as Canelos, in fact it seems that he did not go much farther east than the Rio Mapoto. I wrote to Sra. Rosario Velástigui de Lefebre, an old friend who had collected with me in 1938–1939, about Baron. She replied to my inquiry that her father, José Elias Velástigui, had accompanied Baron and that they had worked their way down the Rio Pastaza, following its banks, as far as Hacienda San Francisco on the Rio Mapoto. Sr. Velástigui not only had accompanied Baron but later was Haensch's companion in the same region and still later taught Macintyre the tricks of professional entomological collecting. His daughter, Sra. Lefebre, and his son Elias continue in the family tradition. Baron's next sortie was to Chimborazo to collect hummingbirds.

The last of the Ecuadorian letters was written from Riobamba on 11 October. Baron had just returned from Chimborazo with 180 hummingbirds that he had collected in three weeks. The next day he was off to Altar, a huge volcanic mountain to the east of Riobamba and across the inter-Andean valley from Chimborazo. From there he planned to return to Cuenca, settle his accounts, and start for home. In an earlier letter he had planned to spend some time collecting the lower slopes of the mountains on the Pacific side of the range. Apparently this did not take place.

In a letter to Strecker dated 8 February 1891, from Alameda, California, he said "At last I am home again after two years trip to Ecuador." There is a penciled note of Strecker's on this letter "If you want me to I will give you names of your butterflies and moths, and as I have said, between myself and a friend will be likely to make a reasonable purchase." Baron went back to railroading. He stayed with this employment until he returned to Germany early in 1893.

Three letters from 1892 in the Strecker collection tell of working on the Ecuadorian material. "During the long evenings in December, Jan. & February I managed to spread a few thousand of Ecuadorian Leps and Mr. Koebele, who has not yet returned from Australia, spread a thousand or two before leaving for that continent. . . . Not a specimen of the Mexican Leps has gone out yet excepting the first shipment

to B. Neumoegen 4 years ago and not a specimen of the Ecuadorians has gone out to date. . . . Should everything go as planned my next trip will be to Costa Rica in April 93." These are quoted from a letter of 25 February 1892 when Baron was living in Fresno, California. On 16 May he wrote from there that "In my spare time I am beginning to set up my cabinet of Hummingbirds of which I now have 120 species and I propose to make it a unique collection."

In November, 1892 Strecker inquired about purchasing Baron's collection. In reply Baron wrote from San Francisco on the 2nd of December "You have asked me the price of the entire collection and to this let me give you the following as answer:

There are probably 14–15,000 from S. A.
6,000 " Mexico
6,000 " California

or say between 27,000 and 30,000. 10% are probably poor specimens. My price for the entire lot is $4,000.00 Cash." Nothing came of this. On 20 January 1893 Baron wrote to Strecker from San Francisco "I am going to Mendocino tomorrow and will make you a shipment of Lepidoptera." This is the most recent letter of Baron that I have read. Sometime in 1893 he returned to Germany, where according to Meissner he established an apiary. For the last 30 years of his life he lived in Ober-Glogau. He had sold a large part of his collection in England en route to Germany but retained about 100 "Schaukästen" (glass-topped drawers ?) of American butterflies for his own collection.

I recall working 30-odd years ago with some material from Gualaquiza, Zamora, and other Ecuadorian localities visited by Baron. Some of this was in the British Museum and some of it in the Staudinger Collection in Berlin. Unfortunately my notes do not state the collector. Perhaps it had been Baron. Some of the specimens that Baron shipped to Strecker are in the Chicago Natural History Museum, those that remain of Neumoegen's collection are in the United States National Museum and Henry Edwards specimens from Baron are in the American Museum of Natural History. There are many specimens in the W. H. Edwards collection at the Carnegie Museum that bear on their labels "O.T.B." in Edwards' handwriting testifying to their origin.

At least some of Baron's hummingbirds were sold to Lord Rothschild and now are in the collections at the American Museum of Natural History in New York City. Mr. Charles E. O'Brien, assistant curator of the department of ornithology, showed some of them to me. They are beautifully prepared. Later Mr. O'Brien, who had read a draft of this manuscript, wrote to me "On page 12 it is stated that Baron re-

turned to Germany in 1893 and spent the last 30 years there. However, we have many specimens here acquired from the Rothschild Collection bearing labels (not the printed Rothschild label) listing O. T. Baron as the collector in Peru within the dates August 1894–June 1895." Thus it appears that Baron made at least one more collecting trip to South America after his move from California to Germany. Whether or not he collected insects on the Peruvian trip I do not know.

This account of O. T. Baron could not have been prepared without the friendly assistance of Dr. Rupert Wenzel of the Chicago Natural History Museum, Dr. George Goodwin, Jr., librarian, and Mr. O'Brien of the American Museum of Natural History, and particularly Dr. C. Don MacNeill and Mr. Hugh B. Leech of the California Academy of Sciences.

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BOOK NOTICE

A REVISION OF THE GENERA *MELANOLOPHIA*, *PHEROTESIA*, AND *MELANOTESIA* (Lepidoptera, Geometridae). By Frederick H. Rindge. Bull. Amer. Mus. Nat. Hist., 126(3):241–434, text figs. 1–163, plates 3–9. 18 Feb. 1964. Paper, $4.50.

This is an evaluation of taxonomic relationships among members of three closely related genera of Ennominae. Aspects of their phylogeny, distribution, and taxonomy are discussed, in addition to presentation of keys, descriptions, and figures of genitalia and uppersides of the moths. In the work, 112 specific and subspecific names are recognized; 59 of them are proposed as new. Nearly all are Neotropical, largely centered in the highlands zone of South America. The new genus *Melanotesia* is proposed for two species, *siderata* Dognin and *intensa* Dognin, both of which occur in the Andes Mountains.—EDITOR.

COLOURED ILLUSTRATIONS OF THE BUTTERFLIES OF JAPAN. By Mitsuo Yokoyama (revised by Teiso Esaki). [In Japanese], 153 pp., 71 colored plates, several distribution maps. Enlarged edition. Published by Hoikusha, 20, 1-Chome Uchikyuhoji-Machi, Higashiku, Osaka, Japan. Price in Japan, 1400 yen (about $4).

This is essentially the book that was published in 1955 which was reviewed by Dr. Harry K. Clench in *The Lepidopterists' News*, 12:56:1958, with an addition, dated 1961, consisting of 17 pages of text and 8 plates. This addition describes and figures 22 species not in the 1955 edition. The text is in Japanese but the scientific names are latinized and there is a latinized index.—E. J. NEWCOMER.

NEW STATE RECORDS AND ANNOTATED FIELD DATA FOR LOUISIANA BUTTERFLIES AND SKIPPERS

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INTRODUCTION

During the past ten years an annotated list of the Rhopalocera of Louisiana was compiled (Lambremont, 1954; Ross & Lambremont, 1963). The present report constitutes a third paper in this series and summarizes collection data for 1962, 1963, and 1964. This supplement adds five new state records (in the list these are marked with *) for Louisiana, which now has recorded a total of 111 species of butterflies and skippers.

Only those specimens that represent significant revisions of our earlier concept of distribution, abundance, range, or flight date, or that are new state records will be mentioned. Many additional collections that duplicate earlier data were made, but these will not be listed in this paper. We have followed the style used in the paper by Ross & Lambremont (1963) and the nomenclature of Ehrlich & Ehrlich (1961) for the butterflies and dos Passos (1964) for the skippers.

The names of collectors and contributors are abbreviated as follows: ETA (Edward T. Armstrong), YHA (Yousef H. Atallah), JBC (Joan B. Chapin), HRH (Henry R. Hermann, Jr.), MMJ (Mary M. Johnson), ENL (Edward N. Lambremont), JBL (John B. Lambremont), BLM (Burt L. Monroe), LDN (Leo D. Newsom), DKP (Dale K. Pollet), GNR (Gary N. Ross), RHW (Ricard H. Witten), and RNW (Roger N. Williams).

SATYRIDAE

Euptychia cymela cymela (Cramer). This satyr was collected in Allen, Calcasieu, Red River, Vernon, Webster, and Winn parishes (= counties) in April, 1962. This extends our known distribution in a southwesterly direction. The species has not been found in the marshy southeastern one-third of the state, and appears to be associated principally with the pinelands.

Euptychia gemma gemma (Hübner). This satyr has been recorded from Calcasieu Parish near the southwestern corner of the State, and also from Natchitoches Parish in the north-central and East Baton

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Rouge Parish in the south-central part of the State. Fresh specimens were caught in April, 1962 and 1964. Its overall distribution resembles that of *E. cymela*, although the record from Baton Rouge (1♂) was obtained on 16 Oct. 1963 (ENL) in an area well away from the pinelands. This specimen was collected in a mixed live oak (*Quercus virginiana* Mill)–sweet gum (*Liquidambar styraciflua* L.) forest that has a very abundant population of *Euptychia hermes* throughout the spring and summer.

NYMPHALIDAE

Chlosyne gorgone gorgone (Hübner). This species was previously known only from the Shreveport area in the very northwest corner of Louisiana. We have collected it in abundance in Grant, Natchitoches, and Winn parishes in central Louisiana during the middle of April of 1962 and 1964. At one location, two miles north of Pollock, Grant Parish, 18 April 1964 (JBL, ENL, and GNR), 9♂♂ and 11♀♀ were taken in an open grassy field in the pinelands. Most were feeding on the aster *Coreopsis lanceolata* L. (Compositae). Hundreds of other individuals were seen at this and other nearby localities. We feel that this species is clearly established as a Louisiana resident.

Chlosyne nycteis nycteis (Doubleday). Lambremont (1954) listed two specimens from opposite sides of Louisiana, while Ross and Lambremont (1963) recorded no new collections of this species. We have found it to be locally abundant although one is likely not to see it except at scattered times. A sizable emergence occurred in a live oak–sweet gum forest bordering the senior author's home between 15–20 May 1963, five miles south of Baton Rouge, during which time 11 fresh males were taken. *C. nycteis* was taken also in Natchitoches, Red River, and West Feliciana parishes in April, 1963 (GNR and ENL). Thus, it appears to be generally distributed throughout Louisiana.

Phyciodes texana seminole (Edwards). This species was taken in Iberville Parish south of Baton Rouge at Plaquemines, 4 May 1963 (ETA). A late season individual was caught on the L.S.U. campus in Baton Rouge on 30 Nov. 1963, 1♂ (ETA). This butterfly is not very abundant in Louisiana, but has been collected at widely separated points at Shreveport and Baton Rouge. It flies from early in the season (April) until late autumn (November).

**Polygonia comma* (Harris). Three new specimens have been taken in Louisiana. All were captured in the Florida Parish area east of the Mississippi River and north of Lake Pontchartrain. The collection data are: West Feliciana: two miles NW of Tunica, 20 March 1963, 1♂, 1♀

(GNR and ENL); East Baton Rouge: ten miles SE Baton Rouge, 22 March 1964, 1♂ (ENL, GNR, and JBL). The latter specimen was found dead on the shoulder of a road.

Nymphalis antiopa (L.). Lambremont (1954) and Ross and Lambremont (1963) recorded four individuals for Louisiana during late summer and early autumn. The captures of two additional specimens have been called to our attention: St. John: Reserve, 14 May 1956, 1♀ (DKP) and East Baton Rouge: Baton Rouge, 5 May 1964, 1♀ (HRH). The latter mentioned specimen constitutes the earliest season record for this species. All six specimens known from Louisiana have been taken in the southeast portion of the State.

Riodinidae

Calephelis virginiensis (Guérin). Lambremont (1954) reported a single male specimen from St. Tammany Parish in his collection. We have taken two additional males from Grant: two miles N Pollock, 18 April 1964 (GNR, ENL, and JBL). Both were obtained while they fed on blossoms of the aster *Coreopsis lanceolata* L. in an open grassy clearing beside a pine forest.

Lycaenidae

Satyrium liparops liparops (Bdv. & LeC.). One additional specimen, from Grant Parish, was collected as a pupa on a sweet gum tree in a dense forest of sweet gum, live oak, and cedar (*Juniperus virginiana* L.) in the Kisatchie National Forest. The adult emerged 12 days later. The collection data are: 18 April 1964, 1♀ (ENL, GNR, and JBL).

**Satyrium calanus calanus* (Hübner). This species constitutes a new Louisiana record, represented by six specimens recently collected in East Baton Rouge Parish. The first was taken in a light trap on the L.S.U. campus: Baton Rouge, 8 May 1962, 1♀ (JBC). The identification was confirmed by Mr. Harry K. Clench. Additional records are: Baton Rouge, 10 May 1963, 1♂ (YHA) caught at night at a lighted window; five miles S Baton Rouge, 25 April 1964, 1♂, 1♀ (ENL) taken at the edge of an oak forest and Baton Rouge, 13 May 1964, 1♂ and 20 May 1964, 1♀ (RNW) caught feeding on sunflowers (*Helianthus annuus* L.). Thus far we have this species only from the vicinity of Baton Rouge, but it has been taken in three consecutive years.

Callophrys gryneus gryneus (Hübner). Ross and Lambremont (1963) reported a single female for Louisiana taken in March, 1962. This beautiful hairstreak now has been taken as follows: Natchitoches: two miles SW Derry, 19 April 1964, 4♂♂ (GNR, ENL, and JBL); West Feliciana:

7♂♂ and 3♀♀ at five different localities between 15 March and 1 April of 1963 and 1964 (GNR, ENL, and HRH). This species was always found on or near red cedar (*Juniperus virginiana* L.). Its distribution in the State in West Feliciana and Natchitoches parishes indicates that it is well established, although it occurs only locally in conjunction with red cedar.

Callophrys henrici turneri (Clench). Two males were reported previously (Ross and Lambremont, 1963) both in West Feliciana Parish. We have subsequently obtained 8♂♂ and 23♀♀ from four different locations in the same parish. Collecting dates were from 15 March to 1 April 1963 and 1964, with the largest single number (21) taken on 21 March 1964 (GNR, ENL, and HRH). The adults were found on redbud (*Cercis canadensis* L.) and red cedar. There is no doubt that this hairstreak is well established in this part of Louisiana.

Callophrys irus (Godart). This species was listed by Lambremont (1954) on the basis of Skinner's report (1907), although Skinner considered *C. irus* and *C. henrici* conspecific. We have obtained a single specimen, a male with an unmistakable stigma on the upper forewing from Grant Parish: three miles E Bentley, 18 April 1964 (GNR, ENL, and JBL). It was resting on false indigo (*Baptisia tictoria* L.) in a pine forest.

Eurystrymon ontario ontario (Edw.). Lambremont (1954) recorded one specimen from New Orleans. Now, a second specimen has been taken. The data are: East Baton Rouge: Baton Rouge, 11 May 1964, 1♀ (MMJ).

**Panthiades m-album* (Bdv. & LeC.). This species is here recorded for Louisiana for the first time. The collection data are: West Feliciana: two miles NW of Tunica, 20 March 1963, 1♀ (ENL and GNR). The specimen was taken in a dense uplands hardwood forest in the bluff lands of the Tunica Hills.

Celastrina argiolus pseudargiolus (Bdv. & LeC.). This lycaenid is not often seen in Louisiana. We have been told of several additional specimens from St. James and St. John parishes along the Mississippi River between Baton Rouge and New Orleans and also have collected a male in West Feliciana Parish on 15 March 1964 (GNR) and a female at Baton Rouge on 25 April 1964 (ENL). D. K. Pollet reported a female from Gramercy, St. James Parish, on 29 July 1959, which is the latest flight date known for this species in the State.

PIERIDAE

Anthocharis genutia genutia (Fabr.). Lambremont (1954) reported

the falcate orange tip from Louisiana for the first time in Jackson and Lincoln parishes. It has since been obtained in Webster Parish (in the north), Natchitoches Parish (in central Louisiana), and West Feliciana Parish (in south-central Louisiana) flying in April. Five males and one female were taken on 4 April 1964 at Shongaloo in Webster Parish (LDN), and two males and two females were netted at two different localities (Grand Ecore and Montrose) in Natchitoches Parish on 19 April 1964 (ENL, GNR, and JBL). The West Feliciana Parish specimen was a male, taken on 22 April 1963 (RHW) at Retreat. Thus, this species is widely distributed in the State, but is much more abundant in the northern half.

Hesperiidae

Achalarus lyciades (Geyer). Only three specimens were reported previously, all taken in the northern and western parts of the State. One additional male was taken in Allen Parish, 25 April 1962 (BLM).

**Thorybes pylades* (Scudder). These four specimens constitute a new state record: Grant: two miles N Pollock, 18 April 1964, 2♂♂ (GNR, ENL, and JBL); Vernon: two miles NE Leesville, 19 April 1962, 1♂ (GNR); Winn: one mile W Winnfield, 18 April 1964, 1♂ (ENL, GNR, and JBL). The male from Vernon Parish was determined by Dr. J. M. Burns. All specimens were taken in pine forests.

Pholisora catullus (Fabr.). Only three specimens were reported previously. The new listings are: Grant: three miles E Bentley, 18 April 1964, 1♀ (ENL, GNR, and JBL) and Winn: eight miles WSW Winnfield, 19 April 1964, 1♂ (JBL, ENL, and GNR).

Megathymidae

**Megathymus yuccae yuccae* (Bdv. & LeC.). A single female has been taken which constitutes the first record of a member of this family for Louisiana. The data are: West Feliciana: one mile E Bains, 1 April 1963 (GNR and ENL). No yucca plants were seen in the immediate area but a large colony of these plants is located about four miles NNW of Bains near the town of Weyanoke. This specimen was sent to Mr. H. A. Freeman who determined it to be typical *M. yuccae* and stated that it constitutes the most western record known for this subspecies.

Acknowledgments

We would like to express our appreciation to Dr. John M. Burns (Wesleyan University, Middletown, Connecticut), Mr. Harry K. Clench

(Carnegie Museum, Pittsburgh, Pennsylvania), and Mr. H. A. Freeman (Garland, Texas) for the determinations that are mentioned in the body of this paper. We also wish to thank those persons listed in the paper who contributed material to this study.

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AN AGGRESSIVE ENCOUNTER BETWEEN *CATOCALA CARA* (NOCTUIDAE) AND *POLYGONIA INTERROGATIONIS* (NYMPHALIDAE)

Upon entering a wooded area of the city limits of Lafayette, Louisiana near the Vermilion River about 2:00 P.M. CST on 22 June 1962, I noticed *Catocala cara* (Guenée) turning up at every hand. I had considered it generally a nocturnal species, seldom active during the day except when startled from its hiding place. Nothing occurred to change my mind until I noticed one of the underwings flying slowly near a wound in an elm tree. The moth settled and began feeding on the sap that issued from the wound. A *Polygonia interrogationis* (Fabricius) was attracted to the same patch of sap. It darted at the underwing, which arose and engaged the butterfly in aerial combat for one or two minutes. Finally both insects settled, about three inches apart, and fed at the same bit of sap for about five minutes. Then the moth ran across the bark in the direction of the butterfly, its wings fluttering in short, rapid strokes that did not exceed a 45° angle above the body. The butterfly, evidently startled, flew off and did not return.

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URBANUS PROCNE AND *URBANUS SIMPLICIUS* (HESPERIIDAE)

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While working with *Urbanus* from both Mexico and the United States, the author found that specimens from the United States previously referred to *Urbanus simplicius* (Stoll) would not key to that species in Evans (1952), but rather to *U. procne* (Ploetz). A large number of specimens has been examined including those in the collections of the California Academy of Sciences, the Los Angeles County Museum, and the collections of H. A. Freeman, Roy O. Kendall, and the author. Included are 150 or more specimens taken in the lower Rio Grande Valley of Texas in October and November, 1963, by Roy and Connie Kendall and the author. None of these specimens is *simplicius*.

Evans (1952) gives a synonymy for each species. Lindsey, Bell, & Williams (1931) list *procne* in the synonymy of *simplicius*, as does Bell (1938). The figure of Lindsey, Bell, & Williams is apparently a copy of that of Skinner and Williams (1922), which is indeed of *simplicius*, but the specimen is from Puerto Barrios, Guatemala. If specimens from the United States had been critically examined, the differences between *U. simplicius* and *U. procne* should have become evident at that time. Both species are listed for the Nearctic area by dos Passos (1964). Evans (1952) mentions specimens of *simplicius* in the British Museum from Texas and Arizona, to Argentina.

Ploetz described *Goniurus procne* from Brasil in 1880. Since that time most authors prior to Evans have considered *procne* a synonym of *simplicius*. However, the two species are easily separable. The genitalic differences appear too great to regard as individual. The vinculum of *U. procne* is even in outline from a lateral view, while that of *U. simplicius* is markedly curved. This is well shown in the figure by Skinner & Williams. In *procne* the dorsal edge (crista) of the valve has a dense brush or scopa which is lacking in *simplicius*. The dorsodistal spine of the cucullus (cuiller of Evans) is double in *procne*, and of only moderate length. In *simplicius* this spine is longer and single. The lower (ventral) edge of the valve bears a dense and more or less continuous fringe of hairs in *simplicius* (purposely omitted from Skinner & Williams' figure—see introduction to that paper). This feature is nearly absent in *procne*.

There seem to be dependable differences in general appearance and

markings as well as in genitalia. The forewing of *procne* is narrower than that of *simplicius*. Representative measurements for *procne* forewing are: Forewing costa 22 mm, outer margin 15 mm, inner margin, 15 mm. Comparable measurements for *simplicius* would be: Forewing costa, 22 mm, outer margin 17 mm, inner margin 15 mm. *Procne* usually has the tails of the hind wing shorter and directed more laterally, a feature that shows up in pinned specimens. This difference should be used with caution, comparing males with males and females with females, since all female *Urbanus* tend to have shorter tails than the males.

There are two markings of value in separating these species. Firstly, near the apex of the forewing underside there is a dark smudge on the wing of *simplicius*. This is reduced to a narrow curved line or row of spots in *procne*. Secondly, the basal line of the hind wing, underside in *simplicius* connects directly to the second costal spot, forming a continuous line. This basal line in *procne* is directed between the first and second costal spots and does not connect with either. This marking alone is diagnostic and will enable one to separate specimens rapidly in a mixed series.

The genitalia of both species are figured by Evans (1952). Evans' figures do not show all the differences mentioned above. Evans also uses the color marking mentioned in the previous paragraph, but as far as I can find, the differences in wing width and the length of the tail are characters not previously used. Since these are qualitative, several specimens of one sex should be compared. One should not attempt to place a single specimen on tail length.

So far the author has seen no specimens of *U. simplicius* from north of the Mexican border. It is possible that this species may occur in the United States. The great majority of records of *simplicius* from the United States have resulted from the belief that *procne* is synonym of *simplicius*.

The present author feels that *U. procne* should be raised from the synonymy as has been done by Evans, and this name used for the brown *Urbanus* with costal fold and uncheckered fringes which is so frequently taken in the lower Rio Grande Valley of Texas, less often elsewhere along the Mexican border, and for some distance northward. It remains to be proven that true *Urbanus simplicius* occurs in the United States.

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MULTIPLE CAPTURE OF *HYPAUROTIS CRYSALUS* AT LIGHT

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In recent years several notes and short papers have been published in the *Journal of the Lepidopterists' Society* concerning captures of Rhopalocera at lights. I have on occasion observed *Leptotes marina* (Reakirt), *Hemiargus isola* (Reakirt), and *Hylephila phyleus* (Drury) attracted to lights at my home in Tucson. Since these three species abound in the immediate vicinity, I attached no special significance to their presence at lights. I accepted the suggestion of Throne (1961) and Welling (1963) that the butterflies had merely been awakened from their nearby resting sites.

Therefore, when John F. Burger, a graduate student in entomology at the University of Arizona, reported the capture of a female *Hypaurotis crysalus* (Edwards) at a black light he had operated on 26 June 1964 at 6,700 feet in the Pinaleño Mts. of Arizona, I dutifully recorded the information and forgot about it.

My memory was severely jolted when, on the night of 8 Aug. 1964, while collecting at a 6-watt G.E. black light at 6,050 feet in the Pinaleño Mts. my companion, Norman Seaborg, discovered a specimen of *H. crysalus* resting on the window of my car about 20 feet from the light. Since there was little activity at the light, the night being rather cool, I retired to my sleeping bag and left the vigil to Seaborg. When I awoke at 1:00 A.M. he told me that he had taken a second *H. crysalus*. While he was speaking a third specimen landed on the sheet. By 3:00 A.M. two more had been captured, making a total of five specimens of which two were females and three males. With the exception of the report of "6 or 7" *Pieris rapae* (L.) at a street light mentioned by Phillips (1962), this represents the largest number of a single species of butterfly at a light on one night which I have seen recorded.

A superficial search of the immediate area early the next morning

failed to turn up a single specimen of *H. crysalus* and there was no abundance of the oak on which the species apparently feeds higher on the mountain. It seems extremely unlikely that five specimens of this species would have chosen resting sites within a few feet of the light considering the apparent scarcity of the species in the area by day. Higher on the mountain we found numerous *H. crysalus* resting on the oaks.

The behavior of the butterflies which were taken at light was quite different from the ". . . lively beast, darting out from its perch in the tops of oaks at the slightest provocation" described by Brown (1957). At the light the butterflies seemed stupefied and reluctant to move. They were easily captured with a cyanide jar and had to be nudged from the sheet. This lethargic behavior of butterflies at light was also noted by Andersen (1960), Donahue (1962), and Mather (1959). This would seem to indicate that a factor is operating other than a belief on the part of the insect that morning has arrived and it is time to get about the business of the day. An inability of the insect's eye to adapt itself to the light suggests itself but presents the paradox of a diurnal insect with a light adapted eye under normal daylight conditions and a loss of this adaptive ability under artificial light conditions. If the lethargy of the butterfly were due to low temperature then it is difficult to explain the phototactic response which caused the insect to fly to the light.

It seems futile to speculate further at this time on possible explanations of the phenomenon of butterflies attracted to light. If the answer is to be found it will probably require rather sophisticated morphological and physiological investigations. Considering the observed behavior of *H. crysalus*, this species might prove to be particularly suited as an experimental organism.

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A COLLECTING TRIP IN YUKON AND ALASKA

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During the summer of 1962, a companion and I had an extended opportunity to collect Lepidoptera in the Yukon Territory and Alaska. Much of the collecting, as might be suspected, was done along the Alcan Highway. Of greater importance, however, were a few less frequented areas which were also sources of material on this rather widespread trip. Despite the weather, which was miserably wet, we were able to take approximately 3,500 specimens. Thirty percent of these were in excellent condition. It is significant to note the capture of eight species of the genus *Erebia*: *fasciata* Butler, *theano* (Tauscher), *youngi* Holland, *erinnyn* Warren, *rossii* (Curtis), *epipsodea* Butler, *disa* (Thunberg), and *discoidalis* (Kirby). A good series of each of the first six species was taken. Viewing the trip as a whole, 56 species of butterflies were recorded.

Our take-off point was Calgary, Alberta on the 11th of June. Three days found us on the Alcan Highway and our collecting began. The first stop of note was Mile 162. Here was the first appearance of *Colias hecla* Lefèbre. As it turned out, we were to follow this species all the way to Dawson City, Yukon. In the next five miles we climbed 300 feet from the Sikanni River valley of Mile 162. This change in altitude was accompanied by a similar change in the species of butterflies to be found. The *Papilio glaucus* L. of Mile 162 were replaced by *Papilio machaon* L. Flying among the *machaon* was *Erebia discoidalis*. The few specimens of the latter that were taken at this location were found in the boggy regions of a burned over hillside which was at the edge of a thickly forested area.

By the middle of June we were on the Dawson–Mayo Highway at Mile 3.6 at which point three fresh *Oeneis jutta* ssp. were taken. At Mile 12.6 we had increased 2,000 feet in elevation. Here the grassy hillsides yielded an excellent series of *Oeneis chryxus caryi* Dyar. The 20th of June found us on the Dawson Highway and our first encounter with *Erebia epipsodea remingtoni* Ehrlich and 1 *Erebia disa*. As was typical of every location at which the former was taken, tall green grass and a small amount of moisture was present. The one *disa* taken was found in heavy timber. *Erebia discoidalis*, as usual, were skirting the forest rims. By this time the heretofore abundant *Papilio glaucus canadensis* Roth. & Jord. were worn and gradually fading from the scene. Individuals of

Colias hecla were so worn that I found it hard to believe they could still fly.

The 24th of June put us into Klondike Pass in the Oglivie Mountains. Here at Mile 45 of what is called the Dempster Highway and at an elevation of 3,800 feet in the moist grassy tundra *Erebia fasciata* were taken in number. Nearly all of the specimens taken were fairly fresh and intact. However, by the 27th of June they were badly worn and becoming scarce. The previous year at this location only one *fasciata* was found, and this on the 6th of July. It seems apparent that due to the short growing season there is very little time when a region is dormant. The lepidopteral cycles seem to be built almost one on top of the other. Therefore, as can be seen, timing is a major factor in northern collecting. For example, *Erebia rossii* began to appear as *fasciata* disappeared. To the right of the road at Mile 45 we climbed a ridge which took us up to approximately 5,000 feet. Here we were well above both the valley and the summit of Klondike Pass (4,300 feet). For the most part, this ridge was composed of very brittle black shale with only minute splotches of mossy vegetation. It was at this location that we caught five *Erebia youngi.* Both males and females were relatively fresh and there was little variation between individuals of the respective sexes. (This was not the case in a Richardson Mountain location collected two weeks later; the variation between the sexes there was fantastic.) About 150 feet below this ridge in a dry, grassy area two extremely dark *Erebia fasciata* were taken. Both were males. The ventral side of one of them was completely free of any trace of mahogany suffusion. This was contrary to what was found in the valley tundra. *Oeneis taygete fordi* dos P. and *Boloria frigga gibsoni* (B. & B.) were also taken at Mile 45. Both species were fresh but only the *Boloria* were taken in any number.

An interesting discovery was made at Mile 48 of Klondike Pass. On the opposite side of the valley from the road, on a hillside marked by melting snowbanks, I took 20 *Parnassius eversmanni* Men. It is interesting to note that there were ten males and ten females. This was the only location at which we ever saw this Parnassius in number in the four days that we spent in the area. Contrary to the 1961 trip, only one *Boloria chariclea butleri* (Edw.) was taken. The previous year it had been extremely abundant. This may be a case of timing.

As we traveled back into the Yukon valley on 27 June, *Colias palaeno chippewa* Edw. was out and fresh, while *Colias hecla* was no longer present. At Mile 7.5 one female *Papilio machaon* was taken. Both time and weather were against us here, so we were unable to collect at this

point any longer. One *Euphydryas anicia helvia* (Scud.) was taken at Hunter Creek just off the Dawson Highway. Unfortunately we were early and unable to remain to obtain futher specimens.

In examining the specimens of *Boloria frigga* (Thunb.), it was noted that a gradational sequence occurred as *frigga saga* (Staud.) flowed into *frigga gibsoni*. The *frigga* taken in the valley of Yukon were much darker than those taken at Klondike Pass. These may be variations due to altitude or perhaps the junction of a Pleistocene separation. A very similar occurrence was noted as far as *Boloria titania* (Esper) and *Boloria chariclea* (Schneider) were concerned. The former was taken almost everywhere along the Alaska Highway in July, while the latter was found only in Klondike Pass and McKinley National Park. For example, at Mile 253.6 on the Richardson Highway a nice series of fresh *Boloria titania* were taken. Two days later at Thorofare and Highway Pass in McKinley Park a beautiful set of fresh *chariclea* was taken. The females taken here were extremely dark in comparison to those found in Klondike Pass in 1961. A black radial suffusion from the body characterized the dark female.

By far the most interesting area collected was in the Richardson Mountains. Of particular note is one location which yielded five species of *Erebia*. These were all taken with a vertical change in elevation of only 1,000 feet. The entire location consisted of a gently benched and rolling mountainside. Vegetation varied from bare rock covered with dried black lichen to mossy tundra. At the lowest elevation (3,400 feet) collected we were still approximately 1,200 feet above timberline. Peak elevation was 4,400 feet. Between 3,800 feet and 4,300 feet a large black *Erebia* was taken. This is believed to be *Erebia erinnyn*,[1] as the female has a large rusty suffusion on the forewings ventrally. It is significantly larger than *Erebia magdalena* Strecker from Colorado, which seems a direct contrast to Warren's[1] characterization of Yukon *erinnyn* and true *magdalena* from Colorado. As I have gathered from Mr. Don Eff in Colorado, the habitat of *Erebia magdalena* is high, dark rock slides near the early part of July. The Richardson *erinnyn* were taken on the 7th and the 11th of July. All specimens, both male and female, were fresh. Another individual was seen in a different location but was on a near vertical black bouldered rock slide. The apparent average elevation for flight concentration seemed to be about 4,000 feet. This was approximately 1,800 feet above the timberline of the region. It must be borne

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[1] *Erebia erinnyn* Warren, 1932, described from Asia, is not included in standard lists of North American Rhopalocera, although it was reported from the Yukon by Warren (1936, *Monograph of the genus Erebia*. British Museum (Nat. Hist.), London). The species is closely allied to *E. magdalena*, and presumably the Yukon *erinnyn* recorded by Warren is included with *E. magdalena mackinleyensis* Gunder in dos Passos' 1964 *Synonymic List of the Nearctic Rhopalocera*.—EDITOR.

in mind that at this latitude the timberline is approaching sea level for we are nearing the Arctic Plain. There could, therefore, be a considerable correlation between the environment of *magdalena* at 11,000 feet in Colorado and *erinnyn* at 4,000 feet in the Richardson Mountains. Approximately equal numbers of both sexes of *erinnyn* were taken.

The Richardson Mountains locality yielded other lepidoptera but none were as plentiful as the *Erebia*. Two rather worn *Papilio machaon* were taken at 4,000 feet. It seems possible that these were carried up by the wind from a lower elevation. One rather small *Boloria improba* (Butler) was taken. Very few *Oeneis* were collected in this locality, and oddly enough, we took only females of *Oeneis polixenes* (F.) and *Oeneis melissa gibsoni* Holland. Better weather and more collecting time might have yielded some males. One additional male *Oeneis* which resembles *O. polixenes peartiae* (Edw.) was also collected. It is considerably smaller than the *polixenes* at the same locality, and the coloration of the upperside is more grey than the buff of *polixenes*. Six males and three females of *Oeneis brucei yukonensis* were also taken. There are two female *Oeneis* which have as yet defied identification. In comparison with 1961, very few *Boloria* were captured. This last year, for example, *Boloria astarte distincta* (Gibson) (det. A. B. Klots) was not even seen. An interesting fact to note is that this year's collecting locations were farther north than those of the previous year. I feel that the lack of *Boloria* was due to elevation. Most of the localities were into the true Arctic tundra rather than taiga.

Our next stop was Eagle Summit, Alaska, and for the first time in many days, we were blessed with good weather. In fact, over 175 specimens were taken in one day. *Boloria napaea* (Hoffmsgg.), *Colias nastes* Bdv., and *Colias palaeno chippewa* were all taken in numbers. Very worn representations of *Erebia youngi* were on hand. These seemed to frequent the damp, boggy depressions lush in green growth. For the most part, we were late at this locality because all the specimens taken were somewhat worn. *Parnassius eversmanni* were taken but not in quantity. A female *Oeneis melissa gibsoni* is believed to have been taken on the summit itself. Another male *Oeneis* thought to be *peartiae* was captured.

The next area of concentration was McKinley Park. Here we took *Colias boothii* Curtis, *nastes* and *hecla* all flying together and fairly fresh. According to persons living in the area, spring was six weeks late. The caribou, for example, did not arrive until the middle of July. The net result was a very apparent clustering of flight periods to complete the lepidopteral cycle in the remaining summer. As at every stop since the

Yukon valley in late June, *Colias palaeno chippewa* were still flying in numbers in mid-July. *Oeneis bore mackinleyensis* dos P. were taken at Toklat River, while a few *Oeneis polixenes* were collected at Highway and Thorofare Pass. At 4,300 feet on Highway Pass, well above the road, one male *Oeneis melissa gibsoni* was taken. Toklat River yielded a nice series of *Erebia theano alaskensis* Holland in the grass amongst the scrub birch.

We came across a very unusual spot in the Toklat River area. Two valleys came together forming a large, delta area at the base of Divide Mountain. Our major obstacle was fording the glacial streams. The water was extremely cold and swift. However, the fordings were well worth the cold feet because here, as well as on Highway and Thorofare Pass, *Boloria napaea* were taken in number and fresh. Because this locality was maneuverable, it was the only area where *Colias nastes* was frequent enough to be taken in numbers. On Divide Mountain itself the gullies were amply boggy from the melting snow. It was here that *Erebia youngi*, *Erebia fasciata* and one female *Erebia rossii* were found. It should be mentioned that the female *rossii* was unusually large in comparison with those females taken in the Richardson Mountains and Klondike Pass in the Oglivie Mountains. *Colias hecla* was taken amongst the *Erebia*, but were somewhat fresher.

Thorofare Pass yielded an excellent series of *Boloria eunomia denali* (Klots) in a boggy area below the road. Of note was the capture of *Lycaena phlaeas hypophlaeas* (Bdv.) at Toklat River and Highway Pass in McKinley Park. Four were taken, three males and one female. We spent seven days in McKinley Park but were only able to collect on two of these days because of torrential rain.

On our way down the Alcan Highway, Mile 1119 yielded a nice fresh series of a very distinct population of *Colias alexandra christina* Edw. There was very little variation among the individuals of the respective sexes. This was not true of the other *Colias* nor is it true of *Colias christina* in Alberta. *Lycaena dorcas* Kirby was also found here along with *Speyeria mormonia* spp. Both were fresh. Mile 718 gave us *Speyeria mormonia opis* (Edw.), and fresh but scarce *Lycaena mariposa* Reak. and *Plebejus argyrognomon* (Bergstr.).

One of the most interesting areas from an ecological standpoint was Liard Hot Springs in British Columbia. Here hot sulphur waters spread over a large area of timber and muskeg. The hillside vegetation was abnormally large and the air was tainted with the smell of hydrogen sulfide. The temperature of the water was high enough to remove permafrost from the area. We were up to our waists in oozing mud

many times. These lowland swampy areas yielded many *Boloria selene* (D. & S.) and *titania*. As we went to higher ground, *Speyeria atlantis* ssp. became more and more frequent and a good series of males was taken.

In summary, we had a very successful trip in spite of the weather. A few questions have arisen in my own mind and so far remain unanswered. The abundance of *Erebia* taken throughout the trip, the corresponding decrease in *Boloria* relative to 1961, and the predominance of female *Oeneis* over males in the northern locations raise questions which can only be solved by continued collecting in the Arctic. Some species such as *Boloria distincta* may be biennial in nature. The shortened summer season may play a significant part here. Most disturbing was the predominance in some species of females over males. This could be due to timing of sampling at given locations. It could, however, be nature's insurance that sufficient females will be bred to assure survival of the species in this rigorous climate. At any rate, more data must be obtained.

I hope in some way the bits and pieces of information that we obtained may be of some aid to others.

I would like to thank my companion, Mr. Lawrence Davidson, for his aid and assistance and the park personnel of McKinley National Park for their time and interest, Western Minerals Ltd., of Calgary, Alberta for the use of their aircraft and camp facilities, and Mr. Don Eff for his help and advice in the preparation of this manuscript.

BOOK NOTICE

INDEX LITTERATURAE ENTOMOLOGICAE, Serie II, vol. I (A–E). By W. Derxen and U. Scheiding. I–XII + 1–697 pp. Published by the German Academy of Agricultural Sciences, Berlin. J. Nawrocki Street 1, Berlin-Friedrichshagen, DDR. Price 55,- DM.

In the German Entomological Institute bibliographical studies have an old and important tradition. The first series of "Index Litteraturae Entomologicae," prepared by W. Horn and S. Schenkling, was published in 1928–1929. In the first series the entomological literature of the world prior to 1863 was recorded.

The world entomological literature of the period of 1864–1900 (contains about 90,000 citations) will be published in four volumes and one volume of index.

The first volume contains citations of the papers published in the mentioned period; the authors' names are recorded alphabetically (Aagaard–Eysell). For most authors the important biographical dates are given.

This monumental work was prepared by the collective of authors in the period of seven years. The "*Index Litteraturae Entomologicae*" is very important for all students in entomology. We wish the authors a successful continuation in their useful work.—JOSEF MOUCHA, Národní museum v Praze, Praha 1, Czechoslovakia

RECENT LITERATURE ON LEPIDOPTERA

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here. Papers of only local interest and papers from this *Journal* are listed without abstract. Readers, not in North America, interested in assisting with the abstracting, are invited to write Dr. P. F. Bellinger (Department of Biological Sciences, San Fernando Valley State College, Northridge, California, U.S.A.). Abstractor's initials are as follows:

[P.B.] — P. F. Bellinger
[I.C.] — I. F. B. Common
[W.C.] — W. C. Cook
[A.D.] — A. Diakonoff
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[C.R.] — C. L. Remington
[J.T.] — J. W. Tilden
[P.V.] — P. E. L. Viette

B. SYSTEMATICS AND NOMENCLATURE

Kawabe, Atsushi, "Descriptions of three new species of the Archipsini from Japan" [in English; Japanese summary]. *Trans. Lepid. Soc. Japan*, 15: 1–7, 2 pls. 1964. Describes as new *Clepsis monticolana* (Mt. Tateyama, Toyama Pref., Honshu); *Hastula hoshinoi* (Setagaya, Tokyo, Honshu); *Philedone violetana* (Nippara, Tokyo, Honshu). [P. B.]

Komarek, O., "Rassen der *Zygaena carniolica* Scop. in der Tschechoslowakei. I. Teil" [in German; Hungarian summary]. *Folia ent. hung.*, s.n., 11: 103–132, 2 maps. 1958. As new describes a form "*bohemica*" from NE Bohemia (region of Hradec Králové); other races from central Europe are discussed. [J. M.]

Kumata, Tosio, "Descriptions of three new species of *Lithocolletis* feeding on *Quercus* in Japan (Lepidoptera, Gracilariidae)." *Insecta matsumurana*, 21: 62–68, 3 figs. 1957. Describes as new *L. nigristella* (Sapporo; on *Q. dentata*), *L. leucocorona* (Sapporo; on *Q. dentata*), *L. cretata* (Nopporo; on *Q. serrata* & *Q. mongolica*). [P. B.]

Kumata, Tosio, "Descriptions of two new species of the genus *Lithocolletis* feeding on *Alnus* in Japan (Lepidoptera, Gracilariidae)." *Insecta matsumurana*, 21: 132–137, 2 figs. 1958. Describes as new *L. longispinata* (Sapporo; on *A. japonica*), *L. hancola* (Sapporo; on *A. hirsuta* & *A. japonica*). [P. B.]

Kumata, Tosio, "Descriptions of a new genus and a new species of Gracillariidae from Japan (Lepidoptera)." *Insecta matsumurana*, 24: 52–56, 2 figs. 1961. Describes as new *CHRYSASTER* (monobasic), *C. hagicola* (Sapporo, Hokkaido; reared from *Lespedeza* spp.) [P. B.]

Kumata, Tosio, "Description of a new stem-miner of coniferous trees from Japan (Lepidoptera: Gracillariidae)." *Insecta matsumurana*, 27: 31–34, 2 figs. 1964. Describes as new *Spulerina corticicola* (Zyôzankei, Hokkaido; reared from *Abies*, *Pinus*, & *Larix*). [P. B.]

de Laever, E., "*Noctua* (*Lampra*) *interposita* (Hübner) bona species" [in French]. *Lambillionea*, 62: 18–19. "1962" [1963]. Gives characters & records of *N. i. baraudi* from Pyrenees & Italy. [P. B.]

Langston, Robert L., "*Philotes* of central coastal California (Lycaenidae)." *Jour. Lepid. Soc.*, 17: 201–223, 6 figs. 1964. Describes as new *P. enoptes bayensis* (China Camp, Marin Co.), *P. e. tildeni* (Del Puerto Canyon, Stanislaus Co.).

Lempke, B. J., "Notes on some species of *Nycteola* Hb. (Lep., Noctuidae)." *Ent. Berichten*, 18: 161–164, 1 fig. 1958. Sinks *pseudodilutana* to *cuneana*, *hungarica* to *asiatica*; notes on these spp. & on *N. populana* & *N. revayana*; names a "form" of the latter. [P. B.]

Lenék, Oskar, "Eine gleichzeitige Zucht von *Boarmia repandata* L. und *Boarmia maculata bastelbergi* Hirschke" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 127–130. 1962. Describes adults of *B. m. bastelbergi* & names 2 "forms." Compares larvae & pupae of these spp. [P. B.]

de Lesse, H., "Spéciation et variation chromosomique chez les lépidoptères rhopalocères" [in French]. *Ann. Sci. nat., Zool.*, ser.12, 2: 1–223, 222 figs. 1960. This important work on the speciation and the chromosomal variation in the Rhopalocera is divided in three parts. In the first the author studies the number of chromosomes in a large number of species. After indications on technique, a list of chromosome numbers for 174 species is given. The indication of these numbers is, for a great part, published here for the first time. The second part is devoted to the classification of *Erebia* of the *tyndarus* group. The author has published these last years a number of papers about this subject and the conclusions are exposed here. The species are the following: *E. calcarius* ($n = 8$), *E. tyndarus* ($n = 10$), *E. cassioides* ($n = 10$), *E. nivalis* ($n = 11$), *E. callias* ($n = 15$), *E. h. hispanica* ($n = 25$), *E. h. rondoui* ($n = 24$), *E. i. iranica* ($n = 51$), *E. i. transcaucasica* ($n =$ ca.52). The geographic distributions of these are given, together with comparisons between classifications from study of the genitalia and from the number of chromosomes. In the third part, comparison is made between cytological results given by the *E. tyndarus* group and that obtained in other Rhopalocera, chiefly in the genus *Lysandra*. In this genus the European and Near East species and some natural hybrids inside the *L. coridon* group are studied. At the end, a discussion on the variation of chromosome number and its interpretation is given. The study of the number of chromosomes is useful in taxonomy (it is a pity that the author uses the unusual term "taxinomie") in the Rhopalocera and in very rare cases is the exception. Owing to such cases, this study notes it is important to know the systematics of the group considered. See also *Jour. Lepid. Soc.*, 14: 147, 1961. [P. V.]

de Lesse, H., "*Boloria napaea* Hoffmsg. retrouvé dans les Pyrénées orientales (Nymphalidae)" [in French]. *Alexanor*, 1: 231–233. 1961. Description of *B. n. pyreneorientalis* (E. Pyrenees, Eyre Valley) and confirmation of the presence of this species in this locality. [P. V.]

de Lesse, H., "Variation chromosomique chez *Agrodiaetus dolus* Hb. (Lep. Lycaenidae)" [in French]. *Alexanor*, 2: 283–286, 1 map. 1962. Chromosomal variations in *A. dolus* and description of *A. d. pseudovirgilia* (Spain, W. of Burgos, near Villanueva de Aragon). [P. V.]

de Lesse, H., "Lépidoptères Lycaenidae récoltés en Iran en 1961" [in French]. *Alexanor*, 2: 305–312; 3: 33–38. 1963. List of the Lycaenidae collected in Iran during a collecting trip in 1961. Descriptions of new *Agrodiaetus: A. baltazardi* (SE Iran, Kuh-i-Lalihzar), *A. cyanea kermansis* (same), *A. modifii* (NE Iran, Kopet Dagh). [P. V.]

Lichy, Rene, "Documentos para servir al estudio de los lepidópteros de Venezuela 6ª nota). Apuntes sobre los *Agrias* Doubleday (Nymphalidae-Charaxidinae)" [in Spanish; French & English summaries]. *Rev. Facult. Agron.*, Maracay, 2: 5–52, 30 figs. 1962. Gives history of studies on this genus in Venezuela; describes & figures the 7 spp. & sspp. found in this country, with data on the 23 known specimens. [P. B.]

Lichy, Rene, "Documentos para servir al estudio de los Sphingidae de Venezuela (Lepidoptera, Heterocera) (10ª nota)" [in Spanish; French & English summaries]. *Rev. Facult. Agron.*, Maracay, 2: 53–178, 55 figs. 1962. Describes as new *Isognathus tepuyensis* (Sierra de Lema); *Perigonia pittieri* (Rancho Grande Biological Station). Complete redescriptions of 12 other spp. (in *Protoparce, Amblypterus, Isognathus, Leucorhampha, Hemeroplanes, Epistor, Pachygonia,* & *Xylophanes*) which are new to Venezuela. [P. B.]

Lipthay, B., "Eine neue *Chamaesphecia*-Art (Lepidoptera: Aegeriidae)" [in German]. *Acta zool. Acad. Scient. hung.*, 7: 213–218, 1 pl., 4 figs. 1961. Describes as new

C. sevenari (Nógrádszakál, N. Hungary; reared from *Origanum vulgare*); also names an "ab." [P. B.]

Lorković, Zdravko, "Zwei neuerliche Publikationen über einige Glieder der *Erebia tyndarus*-Gruppe (Lep., Satyridae)" [in German]. *Ent. Tidskr.*, 82: 197–202. 1961. *E. calcarius tridentina* von Mentzer is regarded as belonging to *cassioides* (sensu Lorković). The specimens from the vicinity of Courmayeur assigned by von Mentzer to *E. neleus, E. aquitania,* & *E. nivalis* are all regarded as belonging to *E. cassioides.* [P. B.]

Lorković, Z., "The genetics and reproductive isolating mechanisms of the *Pieris napi-bryoniae* group." *Jour. Lepid. Soc.*, 16: 5–19, 105–127, 6 figs. 1962.

McDunnough, James H., "A study of some Scopariinae (Lepidoptera) of Nova Scotia, with particular reference to the female genitalia." *Amer. Mus. Novit.*, no. 2054, 10 pp., 7 figs. 1961. Describes as new *Eudoria persimilalis* (Doyles, Codroy Valley, Newfoundland), *E. heterosalis* (Kearney Lake Road, Halifax Co., N.S.). Notes on identity, synonymy, & genital structure of the Maritime Provinces spp. of *Eudoria* & *Scoparia*, except *centuriella* & *penumbralis.* [P. B.]

McDunnough, James H., "A study of the Blastobasinae of Nova Scotia, with particular reference to genitalic characters (Microlepidoptera, Blastobasidae)." *Amer. Mus. Novit.*, no.2045, 20 pp., 18 figs. 1961. Describes as new *Blastobasis maritimella* (Boulderwood, Halifax Co.); *BLASTOBASOIDES* (monobasic), *B. differtella* (White Point Beach, Queens Co.); *Hypatopa titanella* (Pudsey Point, Cumberland Co.); *HOLCOCERINA*, & type *H. simuloides* (Lake Kejimukujik, Queens Co.), *H. simplicis* (Armdale, Halifax Co.). Discussion of genitalia in these genera & *Holcocera*, based on examination of type species. Describes genitalia of *Valentinia glandulella, Holcocera chalcofrontella, Holcocerina confluentella,* & *H. immaculella.* [P. B.]

McDunnough, James H., "Some hitherto undescribed species of Sparganothinae from Nova Scotia, with notes on other indigenous species (Lepidoptera, Tortricidae). *Amer. Mus. Novit.*, no.2040, 11 pp., 5 figs. 1961. Describes as new *Sparganothis scotiana* (L. Kejimukujik, Queens Co.), *S. daphnana* (White Point Beach, Queens Co.), *S. salinana* (Argyle, Yarmouth Co.). Notes on *S. pettitana, S. reticulatana,* & *S. irrorea.* [P. B.]

McDunnough, James H., "Two new species of *Coleophora* from Nova Scotia (Lepidoptera, Coleophoridae)." *Amer. Mus. Novit.*, no.2030, 4 pp., 2 figs. 1961. Describes as new *C. detractella* (Boulderwood, Halifax Co.), *C. simulans* (Coldbrook, Kings Co.). [P.B.]

McGuffin, W. C., "Larvae of the Nearctic Larentiinae (Lepidoptera: Geometridae)." *Canad. Ent.*, suppl.8, 104 pp., 26 pls. 1958. Reviews external morphology of geometrid larvae. Gives keys to subfamilies, & to tribes, genera, & many spp. of Larentiinae. Describes larvae (one or more instars); records food plants, & gives notes on life histories & references to earlier accounts. Proposes MESOLEUCINI to include *Mesoleuca, Earophila,* & *Spargania.* Discusses classification of subfamily & gives tentative phylogenesis. [P. B.]

McHenry, Paddy B., "A rare paper of W. F. Kirby." *Jour. Lepid. Soc.*, 16: 104. 1962.

McHenry, Paddy, "The generic, specific and lower category names of the Nearctic butterflies. Part 1—the genus *Pieris.*" *Jour. Res. Lepid.*, 1: 63–71. 1962. Lists names, including those of nearctic genera of Pierinae, with complete citations, including exact dates, type selections for generic names, & location of types when originally stated. [P. B.]

McHenry, Paddy B., "Generic or subgeneric names closely related to *Argynnis.*" *Jour. Res. Lepid.*, 2: 229–239. 1963. Catalogue of generic names, including type species, and list of names in current use, for the world fauna. [P. B.]

McHenry, Paddy, "The generic, specific and lower category names of the Nearctic butterflies. Part 2. The genus *Colias.*" *Jour. Res. Lepid.*, 1: 209–221. 1963.

Mack, Wilhelm, "Bemerkungen zur Frage der Artberechtigung von *Euchloë orien-*

talis Brem. gen. aest. *ausonia* auct." [in German]. *Nachrichtenbl. bayer. Ent.*, 11: 78–80. 1962. Opposes view that *ausonia* is a distinct sp. rather than a second generation "form." [P. B.]

Mackay, Margaret Rae, "Larvae of the North American Olethreutidae (Lepidoptera)." *Canad. Ent.*, suppl. no.10, 338 pp., 161 pls. 1959. Careful descriptions & figures of larvae of some 185 spp. Keys are given to spp. and to species groups; the latter frequently do not correspond to genera based on adult structure. Suggestions for reclassification are made, on the basis of similarities in larval structure and genitalia. Index to larvae and to host plants. [P. B.]

MacNeill, C. Don, "The skippers of the genus *Hesperia* in western North America, with special reference to California (Lepidoptera: Hesperiidae)." *Univ. Calif. Publ. Ent.*, vol.35, 221 pp., 8 pls., 28 figs., 9 maps. 1964. Describes as new *H. uncas macswaini* (Blancos Corral, White Mts., Inyo Co., Calif.), *H. u. gilberti* (2 mi. SE of Los Reyes, D. F., Mexico), *H. pahaska martini* (4.5 mi. SE of Ivanpah, New York Mts., San Bernardino Co., Calif.). Gives keys to North American spp. Redescribes spp. occurring west of Great Plains, & describes general biology & behavior of the group. It is no criticism of this useful monograph to say that it points out how much needs to be done in this difficult genus. [P. B.]

Malicky, Hans, "Eine neue *Procris*-Art aus Spanien" [in German]. *Ent. Berichten*, 21: 216–217, 3 figs. 1961. Describes as new *P. (Jordanita) vartianae* (Sierra de Alfacar, Granada, Spain). [P. B.]

Marek, J., K. Spitzer, & J. Starý, "*Noctua interposita* Hübner, 1789 in der Tschechoslowakei" [in Czech; German summary]. *Acta Soc. ent. Čechosloveniae*, 61: 190–193, 2 pls. 1964. The distribution of this sp. in S. Moravia with differential diagnosis of related spp. Genitalia & imagos are figured. [J. M.]

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Munroe, Eugene, "Canadian species of *Dioryctria* Zeller (Lepidoptera: Pyralidae)." *Canad. Ent.*, 91: 65–72, 11 figs. 1959. Describes as new *D. rossi* (Nahun, B. C., reared from *Pinus ponderosa*), *D. pseudotsugella* (Seton Lakes, Lillooet, B. C., reared from *Pseudotsuga* & *Abies*). Notes on 7 other spp. Key to spp. [P. B.]

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Munroe, Eugene, "New Pyralidae from the Papuan region (Lepidoptera)." *Canad. Ent.*, 91: 102–112, 20 figs. 1959. Describes as new *Glypodes obscura* (War, Tami R., near Hollandia, New Guinea); *Eoophyla latipennis* (Dojo, near Hollandia), *E. latifascia* (Dojo), *E. thomasi* (Dojo), *E. persimilis* (Dojo); *Margarosticha papuensis* (Bisianumu, Sogeri Plateau, Papua, 1,600 ft), *M. aurantifusa* (Bainyik, Sepik Distr., New Guinea), *M. nesiotes* (St. Matthias Is.). [P. B.]

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Munroe, Eugene, "Pyralidae collected in Lower California by Mr. J. Powell (Lepidoptera)." *Canad. Ent.*, 91: 725–727, 4 figs. 1959. Describes as new *Gyros powelli* (La Grulla, 6,500 ft, Sierra San Pedro Martir). Transfers *Diasemia zephyralis* to *Choristostigma*; places *Pyrausta inconcinnalis* as ssp. of *P. futilalis*. Records of 10 spp. [P. B.]

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SOME TAXONOMIC NOTES ON THE NEARCTIC *HOLOMELINA* (ARCTIIDAE) WITH A PARTIAL KEY TO THE SPECIES

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It is well known that species determination in the genus *Holomelina* Herrich-Schäeffer (not *Eubaphe* Hübner)[1] is difficult. Moreover, the exact application and rank of many of the taxa are certainly questionable. This paper is the first in a series on the biology and species relationships of the *Holomelina.* The objectives of the present paper are: (1) to provide a reliable key to the Nearctic *Holomelina* exclusive of the *aurantiaca* and *opella* complexes, (2) to make preliminary comments on the taxonomy of these complexes as they now stand, and (3) to explain several systematic changes from the current classification as exemplified by McDunnough (1938). Future manuscripts will include taxonomic studies of new species, as well as analyses of distributional, biological, and genetic data.

I. THE HOLOMELINA AURANTIACA COMPLEX

McDunnough's synonymic list cites eight of the twenty-five new world species as occurring north of Mexico, including the generotype, *aurantiaca* (Hübner). This species is the main constituent of a complex that ranges from Nova Scotia to Manitoba, southward through Florida and the Greater Antilles, westward into the Dakotas, Wyoming, Utah, and New Mexico, and thence southward at least to Guatemala. Throughout much of this distribution, several sibling species associate sympatrically with *aurantiaca,* or replace it entirely. A dozen species or forms have been

[1] The genus *Eubaphe* Hübner (1823, Zuträge z. exot. Schmett., 2: 20) has been widely used in the Arctíidae, but when first published, it was monobasic, having as its type, *E. lobula* Hbn., a geometrid; *aurantiaca* Hbn. which is sometimes cited as the type of *Eubaphe,* was not described until a later date (1827–1831, loc. cit., 3: 9). The next valid name to replace *Eubaphe* in the Arctiidae appears to be *Holomelina* Herrich-Schäeffer (1856, Samml. aussereurop. Schmett., 1: 15, 17), the type of which is *aurantiaca* (Fletcher, 1954).

described with the complex; but most of the original descriptions are inadequate, and often the types have been lost, or their identity is uncertain, so that most have been placed in the synonymy with *aurantiaca.*

Clearly at least two of these are referable to separate species. The first, *Holomelina ferruginosa* (Walker) was described in 1855 from St. Martin's Falls on the Albany River, Hudson Bay, Canada and had been assigned specific rank through the time of McDunnough. Because of a lack of clear-cut, structural differences in male genitalia, Forbes (1960) recognized only *aurantiaca* and *lamae* (Freeman) as distinct. He did not comment on *ferruginosa*, presumably due to a lack of reference material. Biologically, however, *ferruginosa* is certainly a separate species, and in addition has priority over two forms, "immaculata" and "trimaculosa," cited by Forbes under *aurantiaca.*

Data assembled from other collectors show that in northern areas where both species are limited to one generation per year, flight periods must be nearly identical and ecological isolating factors are as yet unrecorded. As no difference in the genitalia which might present a physical barrier to copulation has been detected, it is likely that some sort of ecological (i.e., physiological) preference creates a degree of isolation. Moreover, one would expect such siblings to occupy different niches to minimize competition; the mechanism is most likely multifactorial. In other populations, for example, there are evidences of behavioral barriers. Connecticut *aurantiaca* females fly readily, though not quite so far and actively as the males; while *ferruginosa* females are reluctant to fly at all. Different mating times are also quite probable. Under 16-hour photoperiod laboratory conditions, one *aurantiaca* complex strain from New Jersey mated approximately four hours before light switch-off, while a *lamae* strain from Maine mated some four hours after switch-off.

In Connecticut, the total situation is quite different, since *ferruginosa* is single brooded and seems to be isolated by flight period and environment from its double-brooded sibling, *aurantiaca.* The author has taken *aurantiaca* over the last five years in several Connecticut localities between 5–16 June and 3–23 August in open, and often abandoned, fields. *H. ferruginosa* has been collected at Branford, Connecticut (the only known occurrence in the state) in 1963–1964 between 5–30 July. The habitat is somewhat open, grassy woods. At present the exact southern extension of the two species in this type of relationship is uncertain, but its distribution is at least New Jersey through Illinois, according to the report of Wyatt (1939) giving similar observations from Illinois.

The third species, *Holomelina lamae* (Freeman), was described in 1941 from New Brunswick and Nova Scotia with a sphagnum bog habitat and

is currently known from Manitoba, northern Wisconsin, and coastal Maine and New Hampshire. *H. lamae*, like *ferruginosa*, seems structurally identical to *aurantiaca*, but *lamae* populations are strictly confined to this distinct, localized environmental niche, and are thereby isolated from the other two sibling species. Ferguson (1953) reports that in Nova Scotia *aurantiaca* and *ferruginosa* may fly within sight of the bog, but do not enter, so that one may conclude that such isolation is both ecological and behavioral. Ferguson also notes that *lamae* is active diurnally, while the two sibling species in question generally fly only when flushed; *lamae*, on the other hand, is not attracted to "blacklight" as are the other two.

Further information on relationships between these sibling species will come from hybridization studies currently in progress. It would be difficult to measure quantitatively genetic interchange among the three, if such occurs, as each so-called population exhibits extensive but parallel variation, presumably under the control of similar genes. Probably no attempt to describe these siblings could be completely successful, as the number of individual variants in a given population as well as clinal divergence preclude the use of any single character as an absolute. Yet cautious utilization of the following descriptions should suffice for eastern material with the exception of Florida.

Holomelina aurantiaca (Hübner)

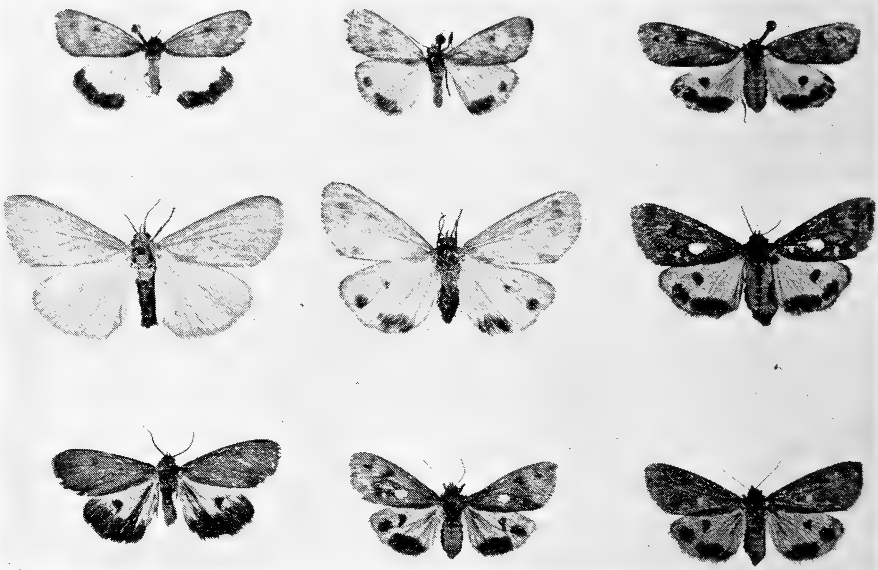
Eubaphe aurantiaca Hübner, 1827, Zuträge z. exot. Schmett., 3: 9

MALE. *Upperside*: Forewing pale orange to brown, often with a darker, obscure postmedial band and discal spot; fringe concolorous. Hindwing light orange to carmine red, rarely light yellow, rarely immaculate, usually a complete, distinct terminal band, often with discal spot; fringe either concolorous with terminal band or with ground color. *Underside*: Immaculate reddish orange, the forewing being a shade deeper than the hindwing.

FEMALE. *Upperside*: Forewing pale orange, in northern material suffused with brown, more heavily over the basal two-thirds; dark, transverse postmedial bands alternate with light orange, partially overscaled with brown; usually a dark, obscure discal spot; whitish cream spots below origin of Cu_2 and beyond (especially in northern specimens). Hindwing light orange, discal spot usually present, terminal markings rarely absent, mostly comparatively reduced to irregular blotches or spots in submarginal area. *Underside*: Forewing immaculate orange. Hindwing lighter, with reduced terminal markings of the upperside, or immaculate.

Palpi, head, and thorax orangish brown to ocher, abdomen orange, often with dorsal and lateral spots on segments, sometimes appearing as an unbroken line or band.

Length of forewing: apex to base, in male 9.5 mm to 11.0 mm, average 10.0 mm; in female 10.0 mm to 12.0 mm, average 11.0 mm; average for both sexes, apex to outer angle 6.0 mm. Hindwing: outer angle to base, 8.0 mm; base to end of vein Cu_1, 8.0 mm.



EXPLANATION OF PLATE

Adults of *Holomelina* (upperside). Top row, *H. aurantiaca* (Hübner): left, ♂, Simsbury, Hartford Co., Connecticut, VIII-11-64; middle, ♂, same data; right, ♀, Farmington, Hartford Co., Conn., VI-9-60. Second row, *H. ferruginosa* (Walker): left, ♂, Branford, New Haven Co., Conn., VII-5-63; middle, ♂, same locality, VII-18-63; right, ♀, same locality, VII-22-63. Lower row, *H. lamae* (Freeman): left, ♂, Seawall Bog, Acadia National Park, Mt. Desert Island, Maine, VII-25-64; middle, ♀, same data; right, ♀, same data.

Holomelina ferruginosa (Walker)

Crocata ferruginosa Walker, 1854, Cat. Lep. Brit. Mus., 2: 535

MALE. *Upperside*: Forewing immaculate light orange or orange generally suffused with brown, darker basally with a dark postmedial and often medial and submarginal bands parallel to outer margin; rarely small whitish cream spots in submedian interspace; dark, indistinct discal spot or bar in darker specimens; fringe concolorous with forewing or fuscous. Hindwing lighter than forewing, usually light orange, often immaculate, rarely pale yellow; terminal band at times present, fragmented into a series of blotches, larger subterminally with upper portions more distant from outer margin, rarely nearly complete; fringe concolorous with ground color or fuscous. *Underside*: Forewing salmon pink, brighter subcostally, more orange near outer margin. Hindwing immaculate light orange.

FEMALE. *Upperside*: Forewing orange, suffused with brown, a dark wavy postmedial band; whitish cream spots usually present. Dark discal spot often elongated into bar over discocellular area; fringe concolorous or dark brown. Hindwing orange or yellowish orange; terminal band rarely nearly complete, not quite to outer margin, usually broken into two irregular blotches, the larger submedially; a thick discal dash, spot or outwardly convex crescent over middle discocellular area. *Underside*: Forewing brownish orange; upperside discal spot or dash, traces of upperside post-

medial as black spots and bars repeated as well-defined black markings. Hindwing has the definitive black terminal markings of the upperside, though somewhat reduced.

Length of forewing: in male 12.0 mm to 13.0 mm, average 12.5 mm; in female 11.5 mm to 13.0 mm, average 12.0 mm; apex to outer angle average, 8.0 mm in male, 7.0 mm in female; outer angle to base average, 9.5 mm in male, 9.0 mm in female. Hindwing: base to end of vein Cu_1, 10.0 mm in male, 8.5 mm in female.

Holomelina lamae (Freeman)

Eubaphe lamae Freeman, 1941, Canad. Ent., 73: 123

MALE. *Upperside*: Forewing dark brown; in most populations (not Maine) a definitive whitish cream spot just below origin of Cu_2; an obscure black spot at upper end of cell. Hindwing light orangish yellow to yellow with a broad, black terminal band extending over at least 40%; inner edge of terminal band sinuous and extending to base along anal veins over fold or inner margin; discal spot large, black, distinct, frequently fused to or included in terminal band; fringe fuscous. *Underside*: Forewing salmon pink with a black discal spot. Hindwing orangish yellow, suffused with black markings in terminal area, especially subterminally, not over veins.

FEMALE. *Upperside*: Forewing brown, as in male, except with distinct orange tinge distally; generally with a larger whitish cream spot below origin of Cu_2, often with additional spots in submedian interspace; dark postmedial band present, often obscured. Hindwing light orange or yellowish orange, occasionally with a broad, black terminal band, not quite to outer margin, usually fragmented into spots and bars larger subterminally and streaked towards base as black shading in the anal region; black discal spot large, distinct, often elongated into a bar; fringe orange–yellow. *Underside*: As in male, with terminal band of secondaries repeated below.

Palpi, head, and thorax reddish brown to orange; abdomen lighter, more often with black dorsal spots on each segment, rarely fused. (In some females such spots may extend into wide bands, and the basal segment is wholly blackish.)

Length of forewing: in male 8.5 mm to 9.5 mm, average 9.0 mm, in female 9.5 mm to 10.5 mm, average 10.0 mm; apex to outer angle average 5.5 mm in both sexes; outer angle to base average 6.5 mm in male, 7.0 mm in female. Hindwing: base to end of vein Cu_1 average, 7.0 mm in both sexes.

II. The status of Holomelina opella nigricans

Crocata opella Grote, 1863, and *C. nigricans* Reakirt, 1864, were both described from Pennsylvania; and although distinct in appearance, have been regarded as forms of a single species by recent authors. Larval descriptions of *Holomelina opella* by Dyar in 1897 and of *nigricans* by Forbes in 1910 indicate that these forms have differences in early stages. The obvious inference submitted by Forbes (1910, 1960), is that *nigricans* is an independent taxon. However, no morphological dissimilarities between the male genitalia (which might be considered mechanical reproductive barriers) have been noted in northern material. Even if these were present, they might not necessarily represent a significant reproductive isolating factor.

Brown (1961) believes that different flight periods and discrete larval differences in themselves do not signify "specificity." The criterion that Brown emphasized in his statistical treatment of wing character variation

in two closely sympatric *Coenonympha* (Satyridae) populations was gene flow from one pool to another, and for him such probable "contamination" or interchange of a great extent precluded any determination of "specificity," even though the units in question apparently were not reproductive isolates, and presumably discrete to a certain degree. Brown viewed the contaminating genes as essentially relative to superficial appearance and not involving any physiological divergence. However, as was pointed out in discussion of the *aurantiaca* complex, such factors may be difficult to determine, especially in view of several practical considerations, viz., yearly fluctuations in the population levels, and difficulty in obtaining wild females and population samples. In addition there is some question as to the identity of the "nigricans" type, so that for the present the author refuses to admit an unqualified separation of *opella* and *opella* "nigricans," and prefers to postpone answering the question by treating the two as a complex.

III. The priority of Holomelina fragilis

McDunnough (1938) recognized both *fragilis* (Strecker) and *costata* (Stretch) as species. A recent examination of the *fragilis* types indicates that they are conspecific with *costata*. *H. fragilis* was described in 1878 from Pagosa Springs, Colorado, seven years before *costata* was described from Texas (collected by Belfrage, but exact type locality unknown). Considerable variation in the gray ground color of the forewing and amount of crimson suffusion is not clearly associated with either a cline or subspeciation as indicated by previous authors. Thus *H. costata pallipennis* (Barnes and McDunnough), described from Glenwood Springs, Colorado, should also fall as a synonym of *H. fragilis*. *H. fragilis* specimens have a pronounced tendency to fade, and this in particular is likely responsible for past confusion.

A partial key to Neartic Holomelina

1. Palpi approximately equal to half head vertex width 2
   Palpi approximately equal to or greater than head vertex width 4
2. HW immaculate orange ocher; FW light fuscous-gray suffused with crimson; underside and costa scarlet .... *fragilis* (Strecker)
   HW terminally shaded with black–brown 3
3. FW underside crimson with black marginal band; FW upper gray–brown with crimson costa; HW crimson to red–yellow with black–brown terminal band .... *intermedia* (Graef)
   FW underside mostly gray or gray–black, crimson costally; FW upper dark gray with crimson costa; HW crimson with light black terminal band .. *laeta* (Guérin)
4. FW yellow–brown with crimson costa; HW crimson with black sinuous terminal band running from below base on inner margin to near apex .... *ostenta* (Hy. Edwards)
   Costal edge concolorous with FW or indistinct HW discoidal spot present 5

5. Males (frenulum simple, hooks present) 6
   Females (frenulum multiple, hooks lacking) 7
6. HW in northern material generally solid blackish; or FW costal edge contrasting; HW markings indistinct; clasper apex forked .... *opella* complex
   HW usually largely orange or bright yellow; clasper apex slender, simple .... *aurantiaca* complex
7. HW with indistinct discoidal spot, and all blackish or mixed with reddish or yellowish ocher with black shaded terminally from inner margin .. *opella* complex
   HW very rarely immaculate, usually black in terminal area and discal spot; in some species shaded towards base along inner margin or fold; FW in northern material often with white spots; abdomen usually with lateral or dorsal black spots .... *aurantiaca* complex

Summary

1. This paper is the first in a series on the *Holomelina*; it suggests several taxonomic changes and indicates areas of uncertainty currently under investigation.

2. The *aurantiaca* complex is widely distributed and consists of several sibling species; those not in confusion are *ferruginosa* (Walker) and *lamae* (Freeman). Identification and several discrete barriers to possible hybridization of these siblings are discussed.

3. Preliminary biological evidence suggests that *opella* and *nigricans* are independent taxa.

4. *H. costata* and *costata pallipennis* are synonymized under *fragilis* (New Synonymy).

5. Males in certain populations of the *aurantiaca* and *opella* complexes are very close in maculation and consequently are best determined by genitalia.

Acknowledgments

The writer would like to express his sincere thanks to Mr. A. K. Wyatt (Chicago) for checking types, Prof. W. T. M. Forbes (Cambridge, Mass.), Mr. D. C. Ferguson (Yale University, New Haven, Conn.), and Dr. C. C. Roys (Tufts University, Medford, Mass.) for helpful advice, and Dr. C. L. Remington (Yale University) for kindly encouragement and counsel throughout much of this work.

For loan of material, the author wishes to thank Dr. P. J. Darlington, Jr. (Museum of Comparative Zoology, Harvard University, Cambridge), and Dr. F. H. Rindge (American Museum of Natural History, New York).

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PROBABLE SECOND U.S. RECORD FOR *EREBIA DISCOIDALIS*

On 24 May 1964 W. R. Pieper, Ray Glassel, and I were collecting in Lake County, Minnesota. About 20 miles north of Two Harbors, we stopped at the little town of McNair. The general area is one of acid bogs, characterized by black spruce, white cedar, and tamarack. Ground cover is mostly mosses (sphagnum, hipnum, haircap, etc.) with occasional gatherings of checkerberry, Labrador tea, leather-leaf, and claytonia.

Just behind the buildings at McNair (NE ¼, S 24, T 56 N, R 11 W) is an open, grassy meadow, sparsely dotted with speckled alder and quaking aspen, both of shrub size. In this meadow we captured three badly worn but typical red-disked alpines, *Erebia discoidalis* (Kirby).

Macy and Shepard (1941)[1] list the only U.S. record for this species as Itasca Park (Clearwater County), Minnesota on 31 May 1935. The most recent literature that I have is Ehrlich and Ehrlich (1961),[2] where the Itasca Park record is again cited as the only U.S. record. We have reason to believe, then, that the three specimens taken by us on 24 May are the second documented occurrence of *Erebia discoidalis* for the U.S. If any readers know of other specimens, I would be interested in the details.

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[1] Ralph W. Macy & Harold H. Shepard, *Butterflies* (Minneapolis: University of Minnesota Press, 1941), p. 91

[2] P. R. Ehrlich & A. H. Ehrlich, *How to Know Butterflies* (Dubuque: Wm. C. Brown Co., 1961), p. 97.

THE LIFE HISTORY OF *PROBLEMA BYSSUS* (HESPERIIDAE)

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Existing in widely scattered colonies from Florida to Texas and north to southern Illinois and Iowa, *Problema byssus* Edwards, is a real prize for the skipper enthusiast. Here in Missouri, in the western part of its range it is confined to the few remaining areas of virgin prairie. Although *byssus* is an extremely local species it is often found to be abundant once a colony is located. The host plant in this region is a tall broad-leaved grass, *Tripsacum dactyloides* L. (gama grass). This plant grows in large beds, usually in the dampest part of the prairie locale. The golden byssus confines its activities to the area of the grass beds, rarely straying farther away than the nearest flowers. Although gama grass grows in many locations other than virgin prairie, *Problema byssus* seems unable to adjust to another habitat.

The species is single brooded, adults flying from early June (males) to late July (stray females). The males emerge at least a week ahead of the females and spend most of their time battling among themselves and visiting nearby flowers. They are especially attracted to milkweed (*Asclepias*), Indian hemp (*Apocynum*), and purple cone flower (*Echinacea*). With the emergence of the first females the habits of the males undergo a radical change. From this point on the males are seldom observed fighting or visiting flowers. Most of their time is now spent in slow, skipping flight back and forth across the grass beds in search of emerging females. The males are active, powerful fliers, difficult to catch. The females are less active, with a slow sluggish flight, rarely straying from the grass beds.

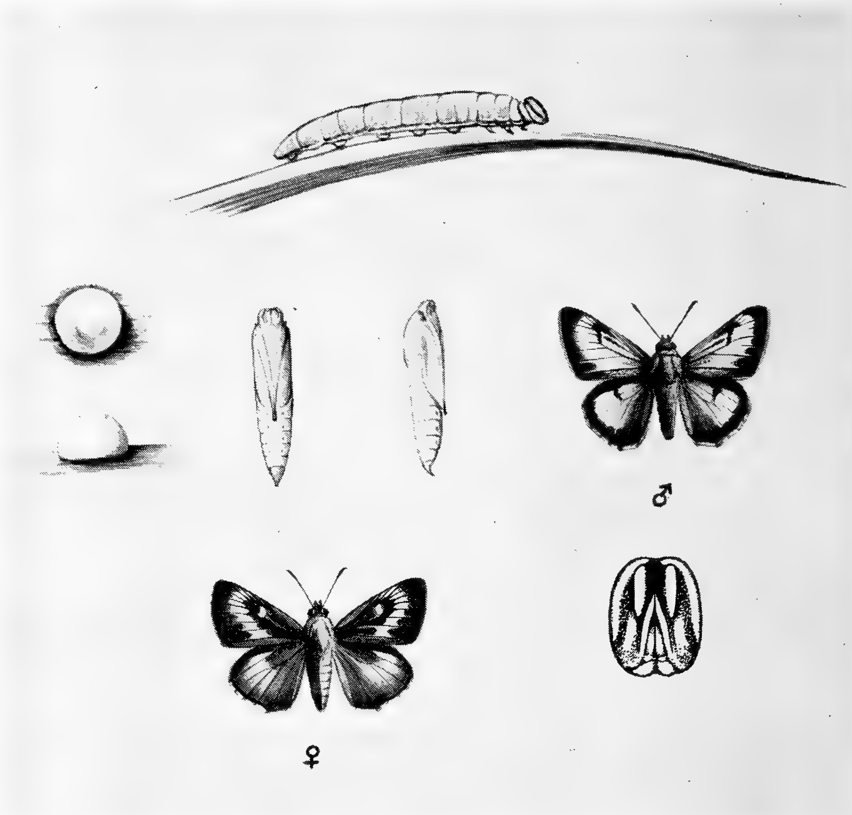
The following life history observations were conducted over a five-year period, 1959 through 1963, on collections taken in the largest known colony in this area. Numerous observations of wild larvae were made during this period in the same locale located just south of Holiday, Kansas, in Johnson County.

Egg. Chalky white, no pattern visible under 25 power magnification. Shape hemispherical, flattened at apex. Width and height about 1.5 mm.

Ova are deposited at random on both upper and lower sides of the leaves. The larvae emerge in eight to nine days.

First Instar Larva. Body pale green, sparsely covered with short white hair; a tiny white mark dorsally at each intersegmental fold; prothoracic shield dark brown, almost black; head dull red brown with numerous yellow hairs, mandibles black.

The larva first eats the entire eggshell and then wanders about the



EXPLANATION OF PLATE

Mature larva, lateral aspect and enlarged view of head case. Egg, lateral and dorsal aspect. Pupa, ventral and lateral aspect. Adult male and female from Holiday, Johnson County, Kansas.

grass blade and selects a spot for its first tent. No preference of position was noted, some larvae choosing the tip, others the base or middle area of a grass blade. The larvae cut a section across the leaf about one-fourth inch deep and fasten the edge back making a tent about one inch in length. The tent is held in place by strong silk strands placed at one-sixteenth inch intervals. On the second day the larvae begin eating, choosing a spot just above the tent.

SECOND INSTAR LARVA. Body color pale watery green, translucent, with blotchy appearance; body without noticeable taper, sparsely covered with bristly white hairs, several longer ones on the anal segment; spiracles protruding, giving appearance of a row of warts along each side; prothoracic shield dark brown; head dull

orange brown, mandibles darker brown; a pale gray band beginning at base of each mandible and extending across face parallel to epicranial suture, following suture to crown; frons slightly raised, dark brown; another dull gray band beginning at back of mandibles follows outer edge of epicranial plates to crown; head thinly covered with white bristles.

The larval tent in this instar measures about two and a half inches in length and is made by folding together an entire leaf and sealing the edges with silk.

Third Instar Larva. Body color pale green, translucent, with a few long hairs on last abdominal segment, thickly dusted with minute black dots; first spiracle on each side enclosed by a silvery wart; prothorax white, prothoracic shield black, extending from spiracle to spiracle; body without noticeable taper; head pale orange brown; two cream-colored bands starting at crown, paralleling epicranial suture to base of mandibles, another cream-colored line follows outer edges of epicranial plates from base of mandibles to crown, a cream-colored line circles the back of head bordering prothorax; frons darker brown and slightly raised; head thinly covered with short white bristles.

Fourth Instar Larva. Body color pale yellow green, last abdominal segment dull yellow; body covered with minute short white hair and thickly sprinkled with very tiny black warts; head light red brown with two white stripes starting at base of mandibles, extending to crown parallel to epicranial suture and continuing around and down outer edge of epicranial plates; frons with two white vertical lines; labrum white, noticeably extended, mandibles much darker brown; prothorax white; prothoracic shield black.

This is the instar in which hibernation takes place. Larvae reared on potted grass plants in the house continue to feed for several weeks at a very retarded rate. Wild larvae, however, follow an entirely different pattern of behavior. Shortly after entering the fourth instar the wild larvae construct a silken lined chamber from three to six inches in length within the larval tent. Although still very active when disturbed, the larvae make no further attempt to eat and their coloring undergoes a radical change. The entire body becomes a pale creamy white covered with minute black bristles. The head turns to a purplish black color with a blistered appearance. There is no visible pattern on the head. The hibernation stage is probably triggered by rain and cool nights which begin to occur in late August in this area. Without these stimuli the larvae being reared on potted grass in the house continue to feed at a slow rate and begin entering the fifth instar in late September. By late April the first warm spring rains have aroused the quiescent larvae and they cut through their silken shroud and begin devouring the tender new leaves of the host plant. For about a week they feed hungrily, growth is fairly rapid but there is no change in the previously described drab coloration of the larvae. After feeding for seven to ten days the larvae enter the fifth instar.

FIFTH INSTAR LARVA. Body color pale yellowish green, last two abdominal segments paler, covered with numerous short white bristles; integument translucent, heart appearing as a bright green middorsal line; a pale yellow shading at each intersegmental fold; prothoracic shield white with a thin black edging from spiracle to spiracle; abdominal area pale greenish white; head deep reddish brown with white bands and markings, area at back of head white; two white bands parallel stalk of epicranial suture to crown and on around outer edges of epicranial plates to base of mandibles; a small vertical white dash at either side of the frons; mandibles dark brown edged with white, labrum white; entire head with a rough texture; frons dark brown with a small central white area, edged with narrow white lines.

SIXTH (FINAL) INSTAR LARVA. Length 37–43 mm; body color dull blue green with a yellowish overcast dorsally; last two abdominal segments powdery white ventrally due to thick pads of wax flake secretions; integument translucent with the darker green heart clearly visible; intersegmental folds appear as yellow rings; body thickly covered with minute white hair when viewed under magnification; spiracles cream colored with a minute green wart above and below each; prothoracic shield dark brown dorsally; body with almost no noticeable taper; head small (only about half the circumference of body), pale reddish brown with cream-colored areas; outer edges of the epicranial plates edged with cream from crown nearly to base of mandibles; arms of epicranial suture narrowly edged, cream-colored; two broad cream-colored lines parallel stalk of epicranial suture; two pale vertical areas located in lower central portion of each epicranial plate; frons cream-colored centrally; mandibles reddish brown; a few short white bristles on head, which has a slightly blistered appearance.

In the last instar the larva rolls a leaf and fastens it for several inches with a heavy silken strand about every fourth of an inch for the length of the tent. These tents measure from seven to nine inches in length and are open at the top and bottom. The tent is provided with a thin lining of silk. As the larvae near full growth they construct their tent from two grass blades. The larvae eat the first few inches from one leaf and where the base of the tent is to begin they eat all but the midrib for about one-half inch. The base of the other grass blade is then eaten away in the same manner and the two blades drawn together and fastened with strong silken strands. This makes a beautiful piece of camouflage as it appears to be a single grass leaf. Wild larvae are observed feeding in the daylight but when approached or the plants are touched they rapidly move backwards to the center of the tent.

COCOON. Dense, of shiny white silk.

The cocoon is spun among the rubbish at the base of the plants, among the grass stems, or in a rolled up leaf near the host plant. In the breeding cage cocoons were also spun on the top and sides of the cage in both vertical and horizontal positions. Pupation occurs three days after the start of the cocoon.

PUPA. Long and slender, 6–7 mm at widest point, 23–27 mm in length; color a beautiful pastel cream with a few tiny brown dots; cremaster a tapering, ventrally curving point, strongly inbedded in silk lining of cocoon.

Emergence of adults occurs about two weeks following pupation.

The time spent in each instar is variable; the following represents an average life cycle.

EGG	: Eggs laid in late June emerge eight to nine days later.
FIRST INSTAR	: Six to seven days.
SECOND INSTAR	: Seven to eight days.
THIRD INSTAR	: Eleven to thirteen days.
FOURTH INSTAR	: About eight and a half months, the hibernation stage covering the period from late August to late the following April.
FIFTH INSTAR	: Ten to thirteen days.
FINAL INSTAR	: Ten days to a little over two weeks (females seem to develop more slowly).
PUPA	: Thirteen to sixteen days. The first adults normally emerging about the start of the second week in June.

My thanks go to Dr. John R. Reeder of Yale University for the host plant determination and to William Howe of Ottawa, Kansas, for the illustration of the life history.

BOOK REVIEW

PRODROMUS LEPIDOPTERORUM SLOVACIAE [Prodromus of the Lepidoptera of Slovakia]. By Karel Hrubý. 1964. 962 pp., 3 maps. Published by the Slovak Academy of Sciences. Klemensova Street 27, Bratislava, Czechoslovakia. Price 83,- Kčs.

Slovakia is an interesting and beautiful country in Central Europe. There are a number of different land formations; in the southern part it is the great Lowland of the river of Danube with xerothermic localities, in the north there are the mountains of which the Tatra is the highest (with the Peak of Gerlach 2,663 m).

The fauna of Lepidoptera of Slovakia was intensively investigated, but results of this work were published in different languages and dispersed in short faunistic contributions. Therefore, comprehensive research work was very difficult. Hrubý's work is of great importance for the students of Lepidoptera in Central Europe.

The introductory parts of the book are written simultaneously in Slovak and Latin. These chapters treat the history of faunistic work of the Slovak Lepidoptera and zoogeography and ecology of butterflies and moths (pp. 5–59). The bibliography (pp. 60–98) contains 889 citations published in the period of 1772–1960. Lists of revised collections and of all recorded localities (pp. 99–127) conclude this part of the *Prodromus*.

The main part of the book (pp. 128–882) is the systematic survey of all species of Lepidoptera and their localities in Slovakia. In this country 2,696 species are recorded.

The index of authors and species (pp. 883–962) finishes this monumental work. "Prodromus Lepidopterorum Slovaciae" is the first complete work about Lepidoptera of Slovakia.

(The author, Professor of Genetics of Charles University, Prague, died in an automobile accident on 10 Dec. 1962).

Josef Moucha, Národní museum v Praze, Praha 1, Czechoslovakia

FIELD NOTES ON *AUTOMERIS ZEPHYRIA* (SATURNIIDAE) AND LARVAE OF *HEMIHYALEA EDWARDSI* (ARCTIIDAE) IN NEW MEXICO

In Juan Tabó Canyon, not far from the type locality of *Callophrys* (*Sandia*) *macfarlandi* Ehrlich & Clench, I captured a fresh specimen of *Automeris zephyria* Grote, at black light, in May, 1958. Near the town of Cedar Crest, southeast of Sandia Crest, another specimen of *A. zephyria* was taken on the porch of a restaurant, where it had come to a lighted window on 14 June 1961.

On the morning of 15 June 1961, while collecting near Highway 66, in the foothills east of Albuquerque, large numbers of last instar larvae of *Hemihyalea edwardsi* Packard were observed on scrub oak; also present, in smaller numbers, were the larvae of an unidentified *Hemileuca* (Saturniidae). In some cases, the abundant *Hemihyalea* larvae had nearly stripped the oaks. They were crawling over the trunks and branches in bright sunlight, which is of interest as the larvae of *H. edwardsi* are strictly nocturnal under usual conditions. They normally hide in crevices in the trunk by day, and come out to feed at dusk, or after dark.

There are some really excellent locations for moth collecting in the Sandia Mountains. In the spring of 1958, I had great success with a portable black light in Juan Tabó Canyon, off a side road which led into a wash with running water. Another very fine collecting area was along the road, from three to ten miles south of the small town of Placitas, on the northeast side of Sandia Peak. Vegetation is varied and luxuriant on the northern and eastern slopes of Sandia, being entirely different from the sparse growth on the southern and western slopes. The road to Sandia Crest (10,700 feet elev.) presents a variety of rich collecting spots, in several different plant associations.

Noel McFarland, South Australian Museum, Adelaide, Australia.

TWO NEW SUBSPECIES OF *MEGATHYMUS YUCCAE* (Bdv. & LeC.) FROM TEXAS

H. A. Freeman[1]

1605 Lewis Drive, Garland, Texas

There has been some confusion for a number of years concerning the status of specimens of *Megathymus yuccae* from Stephensville southward through San Antonio to Laredo. Don Stallings and I have referred to this large region as a "flux" area where specimens seemed to indicate characteristics of several subspecies. Recent studies have presented proof that actually we are dealing with a distinct subspecies showing relationships more closely to *wilsonorum* Stallings & Turner than to *stallingsi* Freeman, with which we had previously primarily associated it. With the naming of this subspecies the status and distribution of the various subspecies of *yuccae* in Texas is clarified.

Megathymus yuccae kendalli Freeman, new subspecies

FEMALE. Upper surface of primaries: flat black, with fairly heavy overscaling of yellowish gray hairs and scales near base; a few light gray scales near apex. Spot 1 (cell spot), squarish, light yellow; subapical spots (2, 3, 4) white, broad, 2–3 mm in width, submarginal spots 5 and 6 narrow, yellowish white; spot 7 square, 4 mm wide and may or may not reach under inner edge of spot 6; spot 8 very much like 7; spot 9 shaped like a broad V with the point directed toward base of wing; all three spots (7, 8, 9) light yellow. Fringes sordid gray, checkered with black at ends of veins.

Under surface of primaries: dull black, with entire outer margin overscaled with gray. All spots reappear, somewhat lighter than above.

Upper surface of secondaries: flat black, with a few light hairs near base; marginal border narrow, sordid grayish yellow. Discal spots are well defined, fairly small, 10 and 11 usually fused together. Only rarely a phantom spot in space 14. Fringes concolorous with marginal border.

Under surface of secondaries: gray around marginal area becoming dull black over discal and basal regions. Two white subcostal spots usually present, the larger one nearer base, broadly linear, the smaller one much narrower.

Abdomen dull black above, beneath only a little lighter. Thorax dark grayish black above, somewhat lighter beneath. Palpi white. Antennal club black with some white beneath, the remaining portion black, ringed with white above, nearly all white beneath.

Length of forewing 30 to 36 mm, average 33 mm. Wing measurements of holotype: forewing, apex to base 33 mm, apex to outer angle 20.5 mm, outer angle to base 25 mm; hindwing, base to end of Vein Cu_1 25.5 mm.

MALE: Upper surface of primaries: flat black, with fairly heavy overscaling of yellowish gray hairs and scales near base; a narrow overscaling of light gray near apex. Spot 1 (cell spot) small and oval. Spots 2 through 6 white. Spot 7 just barely reaches inner edge of spot 6. Spots 7 and 8 rounded on inner edge, 2.5 mm wide. Spot 9 somewhat pointed on inner surface, 3 mm wide. Spots 7, 8, and 9 light to medium dull yellow. Fringes gray, checkered with black at ends of veins.

[1] I wish to express my deepest thanks to the National Science Foundation for GB-398 which is making this research on the Megathymidae possible.

Under surface of primaries: dull black, some grayish scales near apex. All spots reappear, lighter than above, especially 7, 8, and 9.

Upper surface of secondaries: flat black, some yellowish hairs near base; marginal border narrow to medium width, dull yellow. Fringes concolorous with marginal border.

Under surface of secondaries: very similar to female.

Abdomen, thorax, palpi, and antennae as in female.

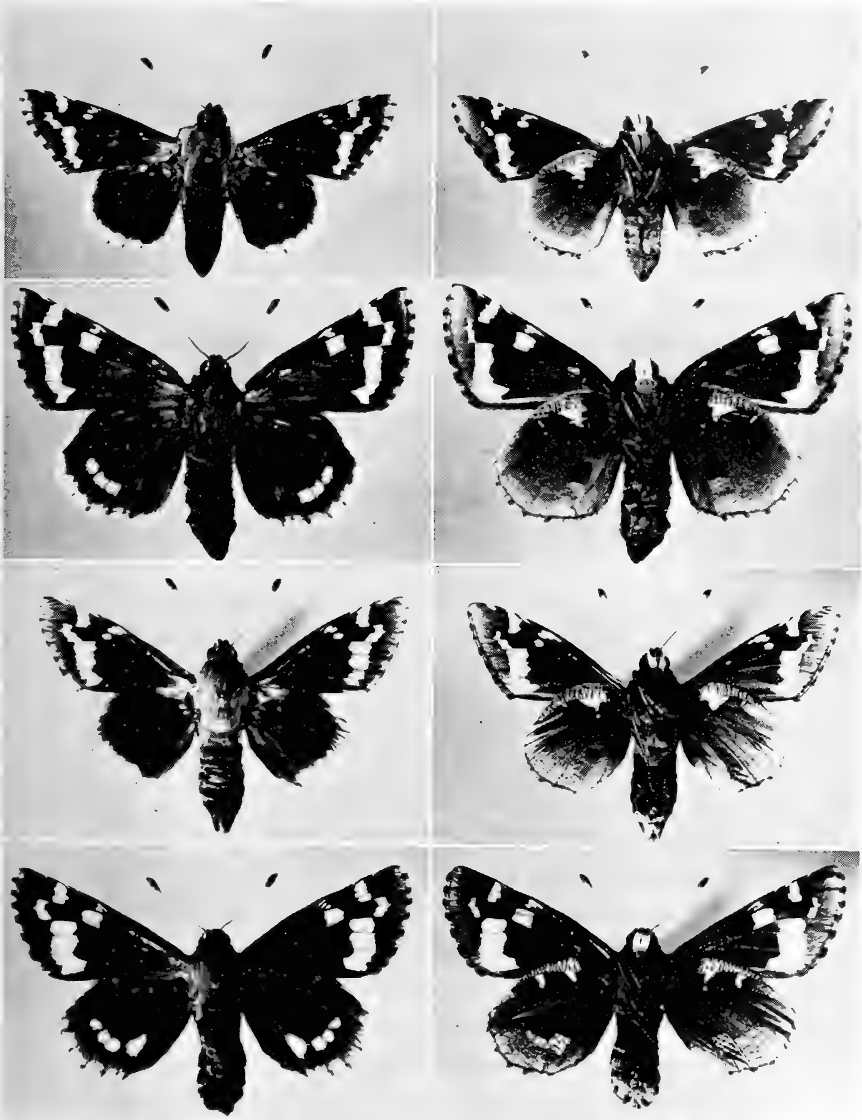
Length of forewing 24 to 30 mm. Wing measurements of the allotype: forewing, apex to base 26.5 mm, apex to outer angle 17 mm, outer angle to base 19 mm, hindwing, base to end of vein Cu_1 18 mm.

Holotype, female, San Antonio, Bexar County, Texas, 12 March 1957, reared in *Yucca constricta* Buckley, pH 7.3; allotype, male, same location and foodplant, 24 April 1958; both were collected by Roy O. and Connie Kendall and will be placed in the American Museum of Natural History. Described from 135 specimens (72 males and 63 females) all reared from larvae; 101 specimens were collected by Roy O. and Connie Kendall at San Antonio, Bexar County, Texas. February, March, and April, 1957–61, in *Yucca constricta* Buckley; 32 specimens were collected by Stallings & Turner at San Antonio in the same foodplant, March–May, 1948–56. One male and one female collected by the author at the same general area March, 1950, pH 7.3, same foodplant. There are five male and 11 female paratypes in the Kendall's collection; 18 male and 14 female paratypes in the Stallings & Turner collection. Paratypes will be placed in the Yale University collection and U. S. National Museum. The rest of the paratypes are in the author's collection.

Associated with this subspecies but not made a part of the type series are specimens collected at the following locations: Inks Lake State Park, Burnet County; U. S. Highway 81, Medina County; Hondo, in cemetery; 12 miles southeast of Laredo, on Highway 83; Eckert, Llano County; Burnet, Burnet County (*Yucca rupicola* Scheele); Stephensville, Erath County (*Yucca pallida* McKelvey); Bluff Dale, Erath County (*Yucca pallida* McKelvey and *Yucca necopina* Shinners); and Cleburne State Park, Johnson County, all in Texas.

I take pleasure in naming this new subspecies for my good friends Roy O. and Connie Kendall who collected most of the type series.

This subspecies is found 50 miles southwest of Cedar Hill, Dallas County, Texas (which is the southernmost record for *M. yuccae stallingsi* Freeman) southward to the Mexican border at Laredo (Map 1). On the west it is replaced by *M. y. louiseae* Freeman, which occurs at Bracketville northward to San Angelo. It does not extend over to eastern Texas where *M. y. reinthali* Freeman occurs, except just east of San Antonio in the Floresville area, where *Yucca louisianensis* Trelease occurs in sandy soil in wooded areas, where the pH is acid. *M. y. kendalli* has not been taken in the lower Rio Grande Valley where *M. y. wilsonorum* S. & T. is



EXPLANATION OF PLATE

Adults of *Megathymus yuccae*; left, upperside; right, underside. Top row: *M. yuccae kendalli* paratype ♂, San Antonio, Texas, 22 April 1948. 2nd row: *M. yuccae kendalli* paratype ♀, San Antonio, Texas, 4 April 1948. 3rd row: *M. yuccae winkensis* paratype ♂, Wink, Texas, 24 March 1963. Lower row: *M. yuccae winkensis* paratype ♀, Wink, Texas, 11 March 1963.

found. The former is associated with open country where the pH is on the alkaline side usually around pH 7.3–7.5. In most places the soil is rather rocky and scrub cedars (*Juniperus*) and mesquite are the dominant plant associates. The center of distribution of *kendalli* appears to be the San Antonio area, where most specimens have been taken from *Yucca constricta* Buckley.

In comparing this subspecies with the others found in this general part of Texas, it differs from *stallingsi* in the following ways: *stallingsi* has the spots bright lemon yellow, whereas in *kendalli* they are dull, light yellow; the ground color in *stallingsi* is dark, shiny black, in *kendalli* it is flat black; in *stallingsi* spot 7 reaches under spot 6 usually, while in *kendalli* it just barely reaches the inner edge of spot 6 and often may be separate from it; in *stallingsi* the females have spots 7 and 8 usually wider than spot 9, but in *kendalli* they are usually somewhat narrower than spot 9. *M. y. kendalli* differs from *reinthali* in the following ways: the spots are much darker yellow in *reinthali*; the ground color of *reinthali* is dark, shiny black, while in *kendalli* it is flat black; the spot shape differs in the females, *reinthali* has all of the spots on both wings larger and better defined than in *kendalli*; in *reinthali* spot 7 reaches well under spot 6 usually, while in *kendalli* it may or may not reach the inner edge of spot 6. *M. y. kendalli* differs from *louiseae* in the following ways: in *louiseae* the spots are yellowish white, while in *kendalli* the spots, although light, are still darker yellow than in *louiseae*; the spots are better defined in *kendalli* in both sexes than they are in *louiseae*; the marginal border of the secondaries is somewhat more narrow in *kendalli* than in *louiseae*; the wing shape is different in both sexes, while *kendalli* has broader wings. *M. y. kendalli* differs from *wilsonorum* in the following ways: the wing shape differs, *kendalli* has broader wings; the marginal border of the secondaries of both sexes in *wilsonorum* is much wider than in *kendalli*; as a general rule individuals of *wilsonorum* are larger than those of *kendalli*; spot 7 is well separated from spot 6 in *wilsonorum*, while in *kendalli* most specimens have spot 7 just barely reaching to the inner edge of spot 6. The genitalia place *kendalli* closer to *wilsonorum* than to any other subspecies of *yuccae*.

Several years ago Stallings & Turner found some old tents of *Megathymus yuccae* in *Yucca campestris* McKelvey at Wink, Texas. Using the information provided by them, I made two collecting trips to this area, one in November, 1962 and the other in November, 1963, to obtain specimens for study. As this area is very sandy and presents a habitat somewhat different from any other in Texas, I was certain that we had something different even before any specimens were seen. The pH is acid being pH 5 for the study habitats. After the first specimen emerged

it was obvious that we had a new subspecies, the description of which follows.

Megathymus yuccae winkensis Freeman, new subspecies

FEMALE. Upper surface of primaries: dark grayish black, with fairly heavy overscaling of grayish yellow hairs and scales near base; a narrow, grayish line of overscaling from apex to about middle of wing just inside fringe. Spot 1 (cell spot) broadly rectangular, yellowish white; three narrow white spots between cell spot and costa; spots 2, 3, and 4 white, broad, 3 mm; spots 5 and 6 prominent, white, 1–2 mm wide; spot 7 reaches to inner edge of spot 6, in some cases one-half the way under it; spot 7 broadly rectangular, 4.5 mm wide; spot 8 broadly rectangular, 5.5 mm wide; spot 9 bent inward at bottom, sharply pointed toward base of wing, not as wide as spot 8, 4 mm wide; all three spots (7, 8, 9), yellowish white, on some specimens almost completely sordid white. Fringes sordid white, checkered with black at ends of veins.

Under surface of primaries: dull grayish black, with the outer margin overscaled with light gray scales. All spots reappear, of the same general coloration as above.

Upper surface of secondaries: dark grayish black, with some slight, lighter overscaling near base; a broad, yellowish white, marginal border 3–4 mm in width; usually a white spot near costa. Markings light yellowish white; spots 10 and 11 usually fused, rather small, 1.5 mm wide; spot 12 rounded, 2.5 mm wide, spot 13 somewhat rectangular, 2–3 mm wide; usually a prominent spot in space 14 varying from phantom-like to a well-defined triangular spot. Fringes concolorous with marginal border.

Under surface of secondaries: dull grayish black, the spots reappearing as lighter areas. Two well-defined, linear, subcostal white spots. A brown, circular dot just above spot 10.

Abdomen dark grayish black above, slightly lighter beneath. Thorax grayish black above, somewhat lighter beneath. Palpi clear white. Antennae with club black, the remaining portion white with minute black rings between segments.

Length of forewing 31–34 mm, average 33 mm. Wing measurements of holotype: forewing, apex to base 33 mm, apex to outer angle 19 mm, outer angle to base 23 mm; hindwing, base to end of vein Cu_1 23.5 mm.

MALE. Upper surface of primaries: dull grayish black, with heavy overscaling of yellowish gray hairs and scales at base; some light grayish overscaling near apex. Cell spot (spot 1) small, oval, white; three linear, white streaks above cell spot near costa; spots 2, 3, and 4 form a curved line, prominent, white, 2–3 mm wide; spots 5 and 6 prominent, white; spot 7 usually extending one-half the distance beneath spot 6; spots 7 and 8 roughly square, 2–3.5 mm wide; spot 9 directed inward along vein, a light streak on vein on outer surface, 3.5 mm wide; spots 7, 8, 9 white in some cases with a very slight yellowish cast. Fringes light gray, checkered with black on veins.

Under surface of primaries: dull grayish black, apical area overscaled with grayish scales. The spots reappear, of the same general coloration as above.

Upper surface of secondaries: dark grayish black, some yellowish gray overscaling near base; a broad, sordid white, marginal border, 3–4 mm in width. Most veins are black, extending through this area. One specimen with two small but distinct discal spots. Fringes same color as marginal border.

Under surface of secondaries: similar to female except grayish overscaling is a little more uniform in appearance.

Abdomen, thorax, palpi and antennae same as in female.

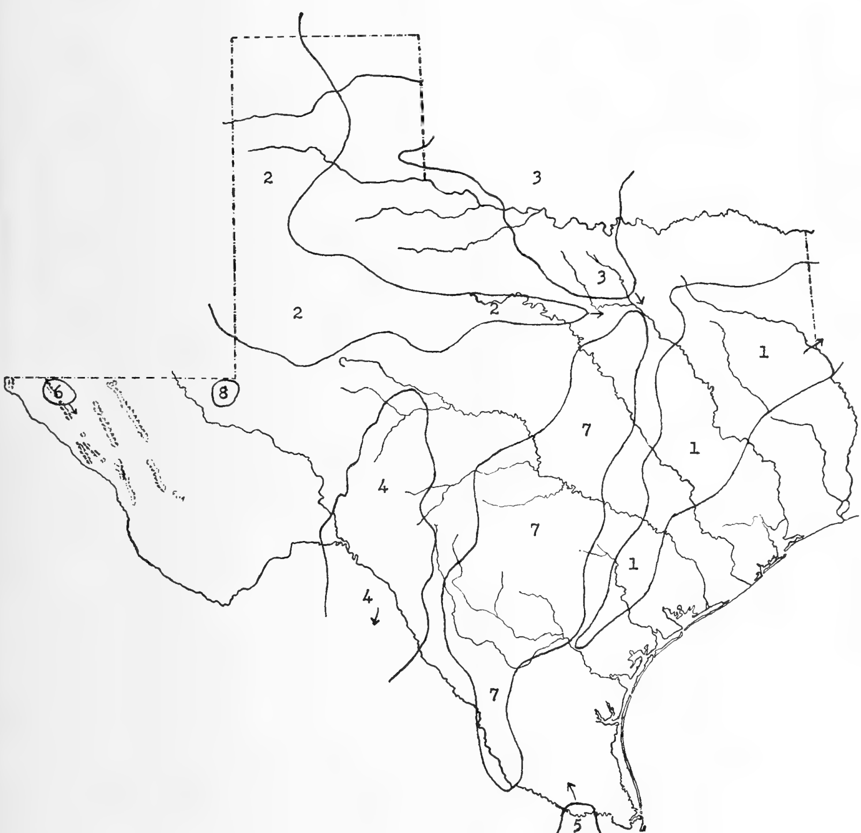
Length of the forewing 23 to 30 mm, average 29 mm. Wing measurements of allotype: forewing, apex to base 29.5 mm, apex to outer angle 18 mm, outer angle to base 21 mm; hindwing, base to end of vein Cu_1 19.5 mm.

Holotype female, Wink, Winkler County, Texas, 16 March 1964, reared in *Yucca campestris* McKelvey; allotype male, same location and foodplant, 9 March 1964, both were collected by the author and will be deposited in The American Museum of Natural History.

Described from 36 specimens (22 males and 14 females) all reared from larvae. Three males and one female were taken six miles north of Pyote, Ward County, Texas, November, 1962 and emerged during February and March, 1963; four males and five females were collected three miles south of Wink, Winkler County, Texas, November, 1962 and emerged during March and April, 1963; 15 males and eight females were collected at the northern edge of Wink, November, 1963 and emerged during March, 1964. All specimens were collected by H. A. Freeman. The type locality is the northern edge of Wink where the soil is red sand having a pH of 5. The elevation is 2,700 feet and the most predominant type of vegetation other than the foodplant, *Yucca campestris* McKelvey, was mesquite, tumbleweed, cacti, sand burs, and *Mahonia*. Apparently this subspecies is restricted to the above-mentioned areas, where the soil is acid. This is the only acid Yucca location that I have so far found in western Texas.

The two subspecies of *Megathymus yuccae* that show closest relationship to *winkensis* are *arizonae* Tinkham and *reubeni* Stallings, Turner, & Stallings. In comparing the males of *winkensis* with *arizonae* the following differences are noted: the wing shape is somewhat broader in *arizonae* than it is in *winkensis*; the ground color in *winkensis* is grayish black, while in *arizonae* it is brownish black; the coloration of spots 7, 8, and 9, as well as the marginal border of the secondaries in *winkensis* is light whitish yellow, while in *arizonae* the same areas are a darker dull yellow. In comparing the males of *winkensis* with *reubeni* the following differences are noted: the wing shape is somewhat broader in *reubeni* than in *winkensis*; *reubeni* has heavier white overscaling along the outer margins and all spots seem to fuse together more than they do in *winkensis*; the ground color of *reubeni* is flat black, while in *winkensis* it is more grayish black; and on the lower surface of the secondaries the subcostal spots are better defined in *reubeni* than they are in *winkensis*. In comparing the females of *winkensis* with *arizonae* the following are noted: the ground color in *winkensis* is grayish black, while in *arizonae* it is more brownish black; the spots are lighter in color in *winkensis* than in *arizonae*; the wing shape is somewhat broader in *arizonae* than it is in *winkensis*; in *arizonae* the discal band of spots on the upper surface of the secondaries are better defined than in *winkensis*, and the phantom spot in space 14 is broadly V-shaped with the point directed toward the base of the wing, while in *winkensis* this spot is more of a distinct, tri-

angular blotch; there are usually two white, oval spots below the outer subcostal spot on the lower surface of the secondaries in *arizonae*, while in *winkensis* these spots are obsolete. In comparing the females of *winkensis* with *reubeni* the following differences are noted: the wing shape is slightly broader in *reubeni* than in *winkensis*; spot 7 usually reaches to the cell spot in *reubeni*, while this rarely occurs in *winkensis*; all spots are larger and more fused together in *reubeni* than they are in *winkensis*; there is more white overscaling in the outer margins of *reubeni* than in *winkensis*; the phantom spot in space 14 on the upper surface of



Explanation of map

Distribution of the subspecies of *Megathymus yuccae* (Boisduval & LeConte) in Texas. 1, *M. yuccae reinthali* Freeman; 2, *M. y. coloradensis* Riley; 3, *M. y. stallingsi* Freeman; 4, *M. y. louiseae* Freeman; 5, *M. y. wilsonorum* Stallings & Turner; 6, *M. y. reubeni* Stallings, Turner, & Stallings; 7, *M. y. kendalli* Freeman; 8, *M. y. winkensis* Freeman.

the secondaries in *reubeni* is more like that in *arizonae* than it is to *winkensis*; there is greater contrast on the lower surface of the secondaries in *reubeni* than in *winkensis*; and in *reubeni* the discal band on the upper surface of the secondaries is more yellow than spots 7, 8, and 9, while in *winkensis* they are all of the same light whitish yellow coloration.

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BOOK NOTICE

ENTOMOLOGIE V. [Entomology, vol. V.]. By Jan Obenberger. 1964. 775 pp., 846 figs., and 12 pls. (of which 6 in color). Published by the Czechoslovak Academy of Sciences. Vodičkova Street, Praha, Czechoslovakia. Price 71,- Kčs.

The fifth volume of the monumental Obenberger's work "Entomologie" (in Czech) contains the orders Trichoptera, Lepidoptera, and Diptera.

The part on Lepidoptera (pp. 69–410, figs. 66–477, 12 pls.) contains a short review on the world system of families with a number of illustrations. In the introductory chapters the morphology and anatomy of all stages of Lepidoptera are discussed in detail.

The part on Lepidoptera in this entomological work is the most comprehensive study about the general problems of this order in the Czech language.

[The author, Professor of Entomology of Charles University, Prague, died at 29 May 1964].—JOSEF MOUCHA, Národní museum v Praze, Praha 1, Czechoslovakia

A NOTE ON *PYRGUS COMMUNIS* AND *PYRGUS ALBESCENS* (HESPERIIDAE)

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The status of *Pyrgus communis* Grote and *Pyrgus albescens* Ploetz is one of the unsettled problems in the study of American Hesperiidae. *P. albescens* has been considered a form or a subspecies of *P. communis*, or a distinct species. *P. communis* occupies a more northern range than does *P. albescens*, a range that comprises most of temperate Canada, the whole of the United States except the lower elevations of the southwest, and the Gulf Region of Texas. *P. communis* also occurs in Mexico, as noted by Evans (1953). *P. albescens* occupies areas in the southwest, in the southern Gulf Region of Texas, and south into Mexico.

A large number of specimens was examined in the course of this study. Specimens from east of the Great Plains proved to be *P. communis*, as did those from Colorado, Utah, and localities north of these states. Brown *et al.* (1956) did not find *P. albescens* in Colorado, but Evans (1953) mentions a specimen in the British Museum from that State. Specimens from northern Arizona, northern and central California, and western Texas were *P. communis*.

Specimens from southern and southeastern California were usually *P. albescens*. *P. albescens* has been recorded from Baja California by Rindge (1948), Powell (1958), and MacNeill (1962). Powell notes that a specimen from Descanso (about 35 miles south of the United States border) is intermediate between *P. albescens* and *P. communis* in genitalic structure, as is characteristic of populations in the San Diego area.

In Arizona, specimens from north of the Mogollon Rim were *P. communis*, as were those from higher elevations in the isolated ranges to the south. The higher elevations of such ranges as the Santa Catalina Mountains and the Santa Rita Mountains yield *P. communis*, while the open desert usually is inhabited by *P. albescens*. At Sycamore Canyon, Santa Cruz County, Arizona, specimens with genitalia of both types were taken. This is a locality of intermediate elevation.

Specimens from the Davis Mountains, Cuesta de Burro Mountains, and other mountains in western Texas (Trans-Pecos) were *P. communis*. East of the Pecos River, at Del Rio, Laredo, Rio Grande City, and on to Brownsville, only *P. albescens* was found. *P. albescens* seems to be the only one along the Gulf Coast, from at least San Patricio County

in the north, south to the Mexican border. This species was recorded from Bayside, Refugio County; Welder Wildlife Refuge, San Patricio County, and Lake Corpus Christi, Live Oak County, south to Brownsville, Port Isabel, Southmost and Boca Chica, all Cameron County. *P. albescens* thus occupies the entire Rio Grande Plains region. Apparently *P. communis* is absent from this region entirely. This is Plant Area 3 of Kendall & Freeman (1963) and all of Vegetational Area 6 plus the southern half of Vegetational Area 2, of Gould (1962).

P. albescens was also taken on the Off-Shore Islands [Mustang Island, Nueces County, 15 October 1963, Kendall & Tilden; Padre Island, Nueces County, same date and collectors; Lower Padre Island (offshore from Port Isabel), Cameron County, 24 October 1963, Tilden].

However, specimens examined from San Antonio, Bexar County, and from Palmetto State Park, Gonzales County, were *P. communis*.

On the basis of available data, it appears that *P. communis* occupies cool and temperate regions, even when such areas occur as islands surrounded by deserts. *P. albescens* seems to be adapted to low-elevational warm areas, which may be either dry (Arizona, southern California) or humid (Gulf Region of Texas).

Most specimens are not difficult to discriminate by genital characters. By brushing away the hairs from the tip of the abdomen of the male, the tip of the valve (cucullus; cuiller of Evans) can be seen easily. If necessary a thin piece of paper may be thrust between the two valvae enabling better visual examination. The tip of the cucullus is prolonged and bidentate in *P. communis* but is very short and monodont in *P. albescens*. Occasional specimens are intermediate, or tend to vary somewhat. Most specimens seem to be recognizably one or the other, and some populations seem quite homogeneous, especially in the northern and eastern parts of the range. However, intermediate populations occur, as in the San Diego region of California, and presumably others might be found with further study.

The phenotypes of the two are so similar that separation by size or color is untrustworthy. In long series, *P. communis* appears a bit larger, and with the ground color a rather dark gray. *P. albescens* in series appears somewhat smaller, the ground color a lighter gray, and in some specimens at least, the white markings more extensive. These differences will not hold for all specimens. No really reliable visual discrimination is possible in many instances.

The smaller average size and slightly lighter coloration of *P. albescens* might be expected of a desert population, as compared with a related population living in a more temperate climate. What significance the

relatively minor difference in shape of the valve of the male may have is certainly obscure, but the geographical manner in which the two conditions of the valve tend to segregate, even if incompletely, suggests some selective value.

There has been no general agreement as to what taxonomic level best expresses the slight but perceptible differences between the insects which have been named *P. communis* and *P. albescens.* One solution is to regard each as a valid species that replaces the other in the proper environment. This course has been taken by Klots (1951) and by Brown *et al.* (1956). The genitalic differences suggest this view. Yet it seems unlikely that this treatment would have been proposed by these workers had they been aware of the degree of intergradation that takes place along some of the interfaces.

A second course is to regard each as a subspecies that replaces the other in the proper environment. This view is taken by Evans (1953), by McDunnough (1938), and by dos Passos (1964). This interpretation also presents some problems. If the ranges are mapped in southern Arizona, we find the interesting condition of one subspecies (*P. communis communis*) existing as small islands surrounded by populations of the other (*P. communis albescens*).

P. communis and *P. albescens*, while perceptibly different, do not seem to exhibit the degree of differences usually associated with either specific or subspecific status. Since each occupies a range, with intergradation along the lines of meeting and in some instances over considerable areas as well, they do not seem to be forms of one another in the usual sense of the term. There seems to be no taxonomic category that expresses their relationship precisely.

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EREBIA DISA MANCINUS IN WASHINGTON STATE: A CORRECTION

Leighton (1946)[1] recorded the satyrid *Erebia disa mancinus* Doubleday from Skyline Ridge, Mt. Baker, Whatcom County, Wash. This record was based on the J. F. G. Clarke collection. Leighton didn't mention that the Clarke records were taken from a set of file cards. Clarke had prepared a complete file of his Lepidoptera collection before leaving Washington State University. This file is now in the W.S.U. Entomology Department. Leighton never actually saw the specimens. The card with *E. disa* title bears the following information: "*Erebia disa mancinus* D. & H., #1573–1577, Skyline Ridge, Mt. Baker Dist, Wash., July 26, 1925. In coll. J. F. Clarke."

This determination was incorrect and rectified by Clarke in 1929. The W.S.U. Entomology Department reprint file contains a typed manuscript by Clarke.[2] In it he refers to *E. vidleri* Elwes from the Mt. Baker Dist. and the Olympic Mts. Also *E. epipsodea* Butler is recorded from Spokane. In addition to this the W.S.U. entomology collection contains four males of *E. vidleri* collected by Clarke in 1932. They are dated (two males) Aug. 26 and (two males) Aug. 27. All specimens are from Skyline Ridge, Mt. Baker Dist., Wash. The two specimens of *E. vidleri* (Clarke, 1929) from the Olympic Mts. are also in the W.S.U. collection.

Thus it appears that the *Erebia disa mancinus* from Washington are only misdetermined *E. vidleri*. Leighton obviously never saw the manuscript of Clarke. An unfortunate mistake was published and is corrected here.

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[1] B. V. Leighton, *The butterflies of Washington* (Univ. of Wash. Press, 1946), Vol. 9, p. 47–63.
[2] J. F. Clarke, *A preliminary list of the Lepidoptera of Washington*, 1929, 37 pages, typed manuscript.

DISTRIBUTION AND HOSTS OF FIVE *PHILOTES* IN CALIFORNIA (LYCAENIDAE)

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In central coastal California, five entities of *Philotes* are known to occur: *Philotes battoides bernardino, P. enoptes bayensis, P. enoptes smithi, P. enoptes tildeni,* and *P. sonorensis* (Langston, 1964).

The detailed area of this study encompasses the region in northern and central California from Humboldt County to San Luis Obispo County on the coast, and inland to the Sacramento and San Joaquin valleys. This area includes both the immediate coastal ranges (North Coast Range, Santa Cruz Mountains, and the Santa Lucia Range), and the inner coast ranges (Mt. Hamilton and Diablo Ranges south to the Tehachapi Mountains).

Two of these *Philotes* (*bernardino* and *sonorensis*) occur to the east and are much more widespread to the south of the above-defined central coastal area. Confirmed records of these localities are indicated on the state maps (Figs. 1 and 3). However, for brevity, this additional distribution is cited by county only.

Host plant associations are included under each *Philotes* along with the distributional records. The data given in detail (locality, date, numbers, and collector) are those that have come to my attention from several lepidopterists since an earlier paper (Langston, 1964) was submitted for publication. Also included are 1963 and 1964 data accumulated subsequent to this paper. Previously published data (Mattoni, 1954; Langston, 1964) are given by locality only, but are repeated here to denote the remaining symbols on the central coastal map (Fig. 2).

In an attempt to more easily picture the distributional patterns, the counties are listed from north to south, rather than alphabetically. The localities within each county are also listed from north to south, in combination with west to east, insofar as possible.

Philotes battoides bernardino Barnes & McDunnough

Philotes battoides bernardino Barnes & McDunnough, 1916, Contr. Nat. Hist. Lepid. N.A., 3(2): 116.

The San Bernardino blue is a late spring and early summer flier. Within the counties where detailed records are given below, it has been associated with *Eriogonum fasciculatum foliolosum* (Nuttall) S. Stokes.

In southern California it has also been found, in most instances, on *E. f. foliolosum*. In addition it has been taken on *E. fasciculatum fascicu-*

latum Bentham along the immediate coast of southern California. In the desert and east slope areas it was found on *E. fasciculatum polifolium* (Bentham) S. Stokes and *E. fasciculatum flavoviride* (Munz & Johnston) S. Stokes.

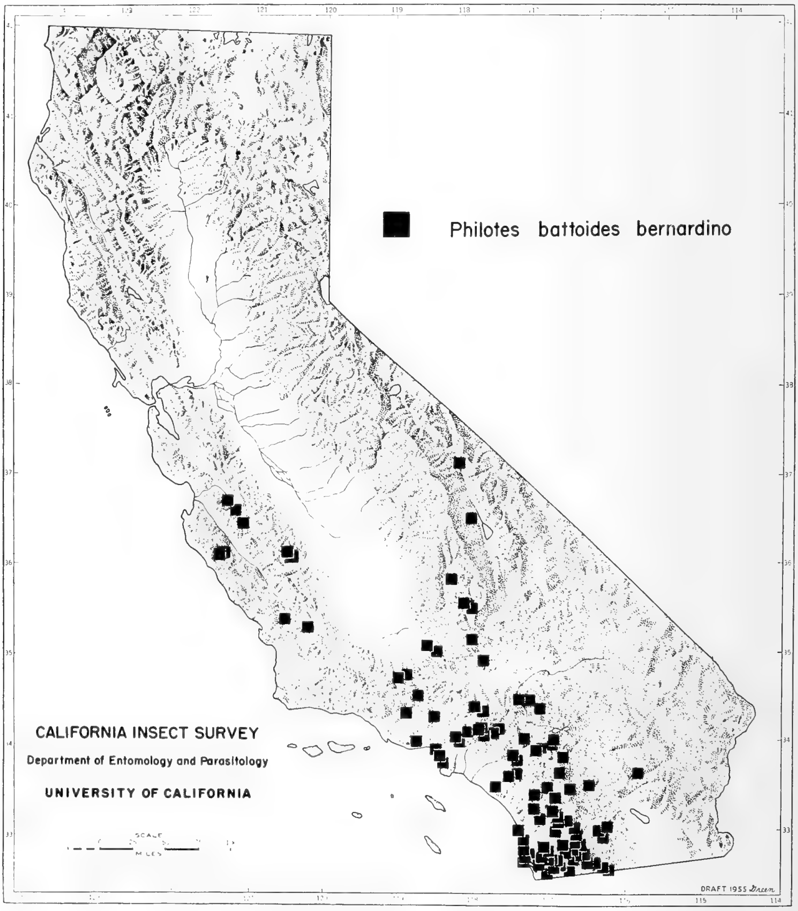
CENTRAL COASTAL RECORDS:

San Benito Co.: Tres Pinos, 3 mi. S, VI-15-1963, 4 ♂♂, 2 ♀♀; Paicines, 12 mi. S, VI-15-1963, 3 ♂♂, 4 ♀♀; Pinnacles Nat. Mon., 4 mi. E, VI-15-1963, 5 ♂♂, 7 ♀♀ (all R. L. Langston).

Monterey Co.: Arroyo Seco; Arroyo Seco, 4 mi. E.

Fresno Co.: Coalinga, 10 & 16 mi. NW, VI-7-1957, 2 ♂♂ (O. E. Sette).

San Luis Obispo Co.: Creston, 3 mi. S, V-4-1962, 1 ♀ (R. W. Thorp); Simmler, 13 mi. WNW, VI-7-1957, 1 ♂ (O. E. Sette).



EXPLANATION OF MAP 1

Geographic distribution of *Philotes battoides bernardino* Barnes & McDunnough in California.

Kern Co. (western part only): Frazier Park, VII-20-1963, 1 ♀ (J. A. Powell); Lebec, VI-9-1957, 2 ♂♂ (P. A. Opler); Tehachapi, 5 & 6 mi. NW, VI-14-1957, 6 ♂♂ (O. E. Sette); near Woodford (Keene P. O.), VI-26-1955, 1 ♂, 2 ♀♀ (J. A. Powell).

California county records (see map 1):

Inyo, Tulare, Kern, Ventura, Los Angeles, San Bernardino, Riverside, Orange, San Diego.

Baja California Norte:

South to Cedros Island (Rindge, 1948); Sierra San Pedro Martir (Patterson & Powell, 1960).

Philotes enoptes bayensis Langston

Philotes enoptes bayensis Langston, 1964, Jour. Lepid. Soc., 17: 208 ("1963").

This blue is a late spring and early summer flier. In Contra Costa and Solano counties oviposition and larval feeding are known to occur upon *Eriogonum latifolium auriculatum* (Bentham) S. Stokes. In Marin and Sonoma counties it is associated with *Eriogonum latifolium nudum* (Douglas *ex* Bentham) S. Stokes. In these counties *auriculatum* and *nudum* are both white-flowered varieties, and tend to hybridize, so that in certain areas (particularly Marin County) the two are almost inseparable. Within the area studied, these plants come into bloom in mid-May and extend into July, with early or "fresh" blossoms in evidence during the flight of *P. enoptes bayensis.*

The discovery of some papered specimens collected in 1907 that had been stored in the basement at the California Academy of Sciences, extended the range of this insect to the north—into Humboldt and Mendocino counties. These two counties are not shown on the central coastal map (Fig. 2), but the localities as noted by the collector are given below. Additional data is given in parenthesis to indicate the areas in relation to places that appear on most state maps.

The complete known distribution is as follows:

Humboldt Co.: Fruitland (near Eel River, SE of McCann), VI-15-1907, 1 ♂, 2 ♀♀, VI-17-1907, 8 ♂♂, 14 ♀♀ (John Strohbeen).

Mendocino Co.: Blue Rock (Creek 2 mi. S of Bell Springs), VI-18-1907, 1 ♂ (John Strohbeen).

Sonoma Co.: Duncan Mills, 2 mi. E to 3 mi. NE, VII-9-1961, 3 ♂♂, 1 ♀, VII-6-1962, 6 ♂♂, 3 ♀♀, VI-29-1963, 1 ♀, VI-30-1963, 6 ♂♂, 2 ♀♀ (N. L. LaDue), VII-5-1964, 3 ♂♂, 1 ♀ (R. L. Langston); Duncan Mills, 2 mi. W, VII-5-1964, 4 ♂♂, 1 ♀; Occidental, 2 mi. W, VII-4-1964, 3 ♂♂, 12 ♀♀; Forestville, 3 mi. W, VII-4-1964, 7 ♂♂, 5 ♀♀; Graton, 3 mi. W, VII-4-1964, 2 ♂♂, 2 ♀♀ (all R. L. Langston).

Marin Co.: China Camp, near Point San Pedro, V-30-1961, 2 ♂♂ (N. L. LaDue); Paradise Cay, 3 mi. SE of Corte Madera, V-30-1961, 27 ♂♂ & ♀♀, V-22-1962, 4 ♂♂, 2 ♀♀, V-29-1962, 37 ♂♂ & ♀♀ (N. L. LaDue); Tiburon, 2 mi. NE; hill above Tiburon, V-23-1964, 2 ♂♂, 1 ♀ (R. L. Langston).

Solano Co.: Carquinez Strait at Glen Cove.

Contra Costa Co.: Point San Pablo, Richmond, VI-12-1964, 7 ♂♂, 3 ♀♀ (R. L. Langston); Point Richmond, V-30-1963, 13 ♂♂, 5 ♀♀, VI-1-1963, 24 ♂♂, 9 ♀♀, V-17-1964, 17 ♂♂, 9 ♀♀, V-27-1964, 18 ♂♂, 9 ♀♀, VI-6-1964, 10 ♂♂, 6 ♀♀, VI-12-1964, 17 ♂♂, 16 ♀♀ (all R. L. Langston).

PHILOTES ENOPTES SMITHI Mattoni

Philotes enoptes smithi Mattoni, 1954, Bull. So. Calif. Acad. Sci., 53: 160.

This blue is a late summer flier, and has been associated with *Eriogonum parvifolium* Smith.

Surveys were made in 1962 and 1963 between the northern and southern records indicated. Although the foodplant was found in abundance along the immediate coast (particularly near Point Lobos and to the north of Big Sur), no additional colonies of *P. enoptes smithi* were found. Attempts were previously made to discover the race both to the north and south of the open circles on the map (Fig. 2), as noted by Langston (1964). The localities below have been published (Mattoni, 1955; Langston, 1964), and are not given in further detail.

The complete known distribution is as follows:

Monterey Co.: Marina Beach, dunes; Seaside, dunes, VIII-19-1963, 2 ♂♂, 3 ♀♀ (R. L. Langston), VII-26-1964, 8 ♂♂, 3 ♀♀ (P. A. Opler); Monterey, "sand hills"; Paraiso Springs; Burns Creek, State Hwy. 1 (Type locality); Dolan Creek, State Hwy. 1; Lucia, 3 & 4 mi. SE, VIII-6-1956, 6 ♂♂, 4 ♀♀ (O. E. Sette); Gorda, 4 mi. N.

PHILOTES ENOPTES TILDENI Langston

Philotes enoptes tildeni Langston, 1964, Jour. Lepid. Soc., 17: 212 ("1963").

This blue is a late summer flier, and has been taken in association with yellow-flowered varieties of *Eriogonum latifolium* Smith. The plant subspecies varied with localities, and is cited with the detailed records below. All of these plants come into bloom in August and extend until October, with early or "fresh" blossoms in evidence during the flight of *P. enoptes tildeni*.

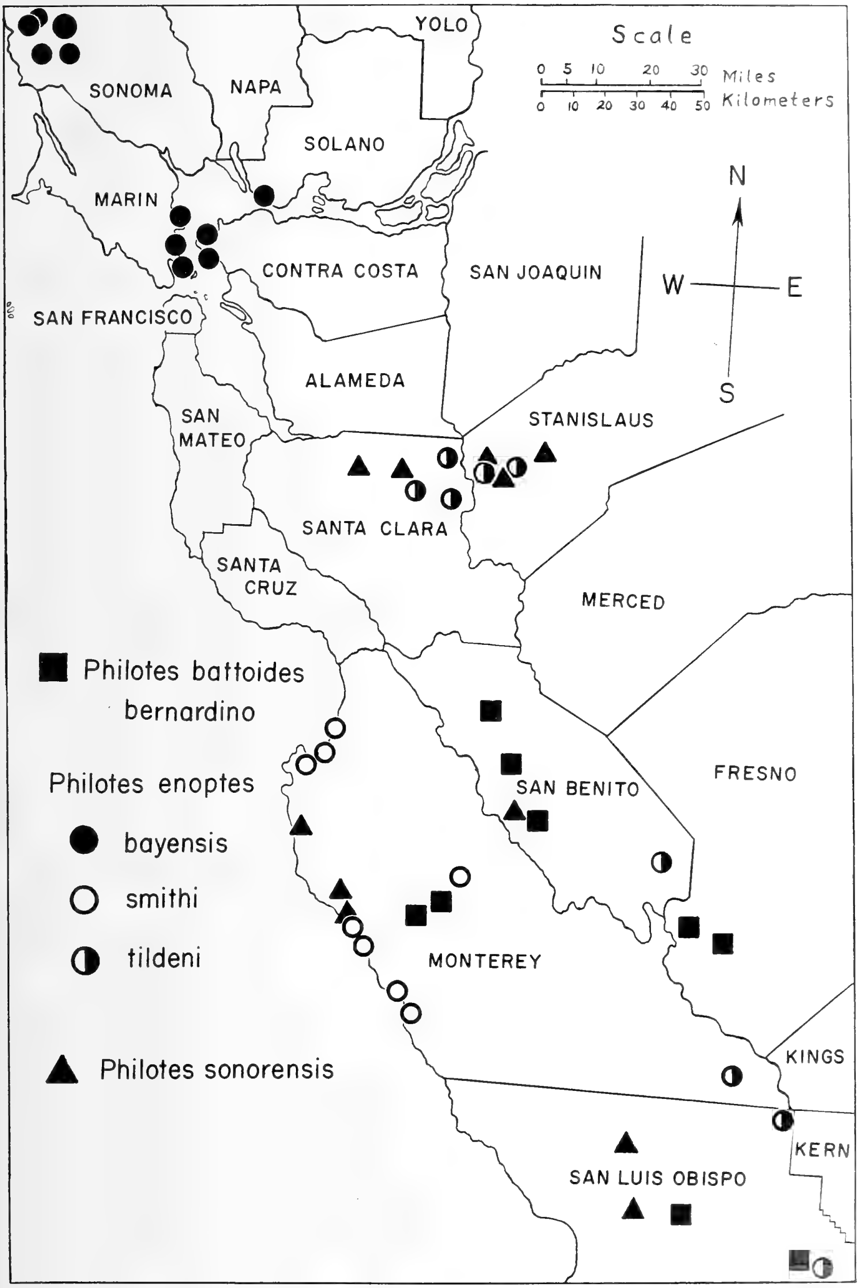
Additional surveys extended the range of this insect considerably, into San Benito, Monterey, and San Luis Obispo counties. Colonies could occur all along the Diablo Range between these new records and the northern locales. Much of the range is rather inaccessible, with the greater part of the existing roads following the valleys.

The complete known distribution and associated plants are as follows:

Santa Clara Co.: Arroyo Bayo, E base of Mt. Hamilton; San Antonio Valley, E & NE of Mt. Hamilton [*Eriogonum latifolium nudum* (Douglas *ex* Bentham) S. Stokes].

Stanislaus Co.: Del Puerto Canyon, 22 mi. W of Patterson, IX-11-1963, 12 ♂♂, 2 ♀♀ (R. L. Langston & J. A. Powell); 18 mi. W of Patterson [*E. latifolium auriculatum* (Bentham) S. Stokes].

San Benito Co.: Call Mts. above New Idria, VIII-27-1964, 4 ♀♀ (Langston, Powell & P. A. Opler) (*E. latifolium auriculatum*).



Explanation of Map 2

Geographic distribution of *Philotes* in central coastal California.

Monterey Co.: Parkfield, 3 mi. SE, VIII-23-1963, 1 ♀ (Powell) [*E. latifolium saxicola* (Heller) S. Stokes].

San Luis Obispo Co.: Cottonwood Pass, 6 mi. NE of Cholame, VIII-23-1963, 1 ♂ (Powell), VIII-26-1963, 5 ♂♂, 1 ♀ (Powell & O. E. Sette), IX-20-1963, 1 ♀ (Sette), IX-11-1964, 3 ♂♂, 2 ♀♀ (Langston & Powell) (*E. latifolium indictum* Jepson); Simmler, 8 mi. W, IX-11-1964, 4 ♂♂, 4 ♀♀ (Langston, Powell & A. J. Slater) (*E. latifolium saxicola*).

PHILOTES SONORENSIS (Felder & Felder)

Lycaena sonorensis Felder & Felder, 1865, Reise Freg. Novara, Lepid. 2(2): 281.

The Sonora blue is an early to late spring flier. Adults have been taken from early February to May depending on elevation, and exposure of the rocky areas upon which the foodplant occurs. Latitude appears to have little effect, as the adult flight in many seasons is as early in northern as in southern California.

The larvae are known to feed on various members of the stonecrop family (Comstock, 1927; Comstock and Coolidge, 1930). In southern California *P. sonorensis* has been associated with stonecrops with erect, terete leaves (*Stylophyllum*), and others having angular fleshy rosettes (*Sedum* and *Dudleya*). However, recent classifications place all of the California *Stylophyllum* and many species of *Sedum* in the genus *Dudleya*. In the central coastal area, *Philotes sonorensis* has been found to be associated exclusively with *Dudleya cymosa setchellii* (Jepson) Moran.[1] Exact host determinations would be necessary to know whether this blue feeds on anything other than *Dudleya* under present taxonomic concepts.

Central coastal records:

Santa Clara Co.: Alum Rock Park, II-21-1954, 1 ♂, III-11-1956, 2 ♂♂, 2 ♀♀, II-22-1964, 7 ♂♂, 1 ♀, III-7-1964, 1 ♂, II-11, 13-1965, 2 ♂♂ (P. A. Opler), III-21-1957, 3 ♀♀, IV-2-1960, 1 ♂ (O. E. Sette), II-12-1964, 12 ♂♂, 5 ♀♀ (R. L. Langston), II-14-1965, 4 ♂♂, II-19-1965, 10 ♂♂, 4 ♀♀ (A. J. Slater); Arroyo Del Valle, E base of Mt. Hamilton.

Stanislaus Co.: Adobe Creek; Del Puerto Canyon, 22 mi. W of Patterson, III-5-1963, 1 ♀, IV-30-1963, 1 ♂, II-22-1964, 2 ♂♂ (Langston); 21 mi. W of Patterson, II-22-1964, 3 ♂♂, 5 ♀♀ (Langston).

San Benito Co.: Pinnacles Natl. Mon., north road, III-31-1962, 1 ♂ (D. C. Rentz).

Monterey Co.: Carmel, 10 mi. S, IV-14-1963, 1 ♂ (D. W. Conard); Big Sur, V-4-1952, 2 ♀♀ (T. W. Davies); Partington Canyon, 9 mi. S of Big Sur, IV-21-1956, 5 ♂♂ (P. A. Opler), V-11-1964, 2 ♂♂ (R. M. Brown).

San Luis Obispo Co.: Paso Robles, III-10-1894, 1 ♂ (W. G. Wright); Atascadero, III-6, 7, 8-1932, 7 ♂♂, III-13, 16-1932, 4 ♂♂, IV-4-1932, 1 ♂, III-14, 26-1935, 2 ♂♂, IV-5-1935, 1 ♂, 1 ♀ (V. L. Clemence).

California county records (see map 3):

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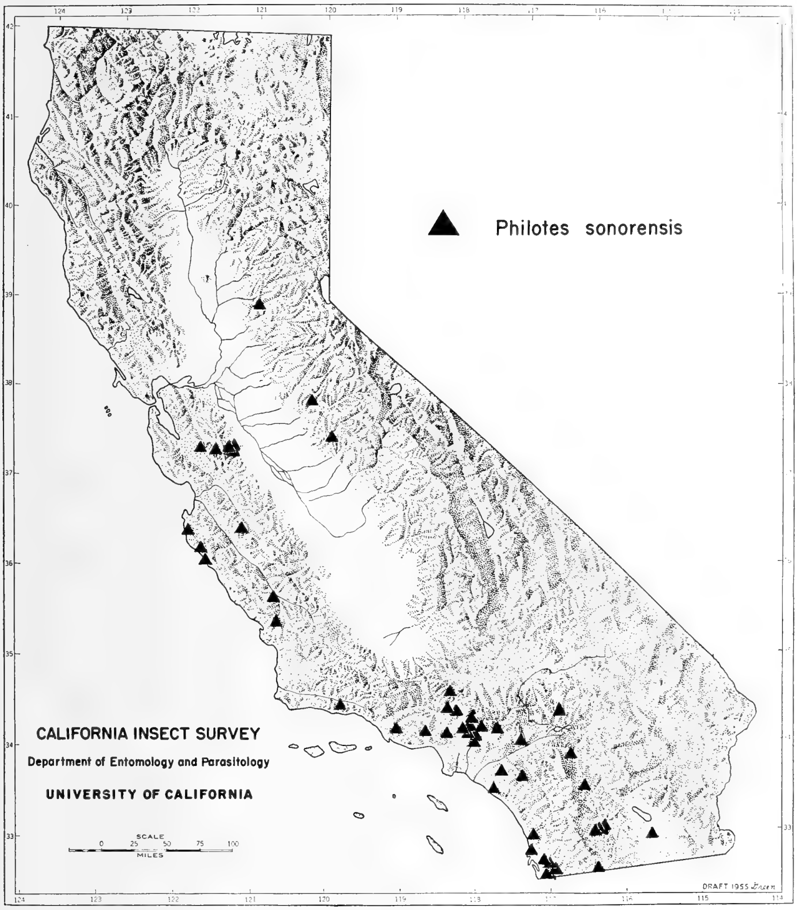
[1] During recent collecting in Placer county (N. Fork, American River E. of Auburn, III-23-1965, Langston), two females were taken resting on *Dudleya cymosa cymosa* (Lemaire) Britton & Rose (det. by Reid V. Moran, San Diego Nat. Hist. Mus.). In Tuolumne and Mariposa counties, *Dudleya cymosa minor* (Rose) Moran was found in abundance, but the small number of males collected were not directly associated with this plant.



EXPLANATION OF MAP 3

Geographic distribution of *Philotes sonorensis* (Felder & Felder) in California.

Placer, Tuolumne, Mariposa, Santa Barbara, Ventura, Los Angeles, San Bernardino Orange, Riverside, San Diego, Imperial.
Baja California Norte:
South to vicinity of Punta Prieta (Powell, 1958).

ACKNOWLEDGMENTS

I wish to acknowledge the helpful cooperation of the following for making available specimens for examination, and data from private and institutional collections in their care: Noel L. LaDue, Sacramento; C. D. MacNeill, California Academy of Sciences, San Francisco; Lloyd M. Martin, Los Angeles County Museum; Paul A. Opler, San Jose; J. A.

Powell, California Insect Survey, Berkeley; O. E. Sette, Los Altos; and J. W. Tilden, San Jose State College. The assistance of Helen K. Sharsmith, Herbarium of the University of California, Berkeley, and that of J. T. Howell, California Academy of Sciences, is greatly appreciated for the many plant determinations.

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BOOK REVIEW

FAUNA OF THE U.S.S.R., LEPIDOPTERA, VOL. 4, PART 2, TINEIDAE, PART 2. SUBFAMILY NEMAPOGONINAE. By A. K. Zagulajev, 5 May 1964, 424 pp., 385 text figs., 2 colored pls. Published by the Zoological Institute of the Academy of Sciences, Moscow & Leningrad, U.S.S.R. (new series no. 86) [In Russian].

This new volume of the "Fauna" forms the second part of the extensive monograph of the interesting family, of which the third part has been published already four years ago (cf. my review in this journal, vol. 15, no. 2, pp. 130–132, 1961). The present volume comprises an extensive treatment of the second subfamily, the chiefly mycetophagous Nemapogoninae, with regard to the species occurring in the Soviet Union and the adjoining countries. The source of the material is the same as before, the collections in Leningrad and Moscow, personal collecting by the author, and Wocke collection.

The set up of the work is about the same as of the third part. A chapter on general morphology of adult and immature stages comprises 55 pages; it is followed by remarks on biology; on classification and phylogeny; and on geographical distribution. Then a chapter on economic importance of the insects is added where the injury, the measures,

and the technique of their application are described. Several species belonging to the subfamily represent serious temporary or permanent pests of certain stored products, as grain, grain products, products of bakeries, and also dried fruits and dried mushrooms (used for food). An extensive list of literature completes the general part.

In the special part the subfamily Nemapogoninae is treated systematically, starting with an extensive description of the subfamily in order to discriminate it from the closely allied first subfamily, Scardiinae. The Nemapogoninae are divided into three new tribes, viz. 1. Triaxomerini, containing the genera *Neurothaumasia* Le March (6 species), *Triaxomasia* g. n. (1), *Triaxomera* Zag. (3), and *Nemaxera* g. n. (1). 2. Nemapogonini, with *Petalographis* Zag. (2), *Nemapogon* Schr. (2), *Anemapogon* Zag. (8), *Paranemapogon* g. n. (2), *Archinemapogon* Zag. (5), and *Longiductus* g. n. (5), and 3. Haplotineini, with a single genus, *Haplotinea* Diak. & Hint. (3). Altogether 11 genera with 57 species, five of which are new, are treated.

For the identification of the genera three different kinds of keys are presented, based on external characters, on male, and on female genital characters. For identification of the species three similar kinds of keys are available and besides, a key based on larval chaetotaxy.

Numerous text figures illustrate head with mouthparts, wing neuration of all genera; and the adult and the male and female genitalia of every species.

Larval chaetotaxy of more injurious species is given and illustrated. Seventeen species are illustrated on colored plates.

For the classification of genera wing venation, mouthparts, and genitalia of the two sexes are used. In this part abbreviated literature references are given not only for the species (as in the previous part) but also for the genera which is a better practice. The merits of the present (second) part of the monograph are similar to those of the already published third part, but exceed that in the completeness of description, the number of treated species in this subfamily being the same, while the amount of pages doubled. Therefore, the work may justly serve as a standard which the student of any other group of Microlepidoptera may copy to his advantage.

The author may be congratulated with this excellent piece of work. It forms a further step towards the completion of the revision of the Palaearctic representatives of the Tineidae and a sound basis for further study of the taxonomy of this interesting group. I have no doubt that the concluding part, Scardiinae, will follow soon.

A. Diakonoff, Rijksmuseum van Natuurlijke Historie, Leiden, NETHERLANDS

FLIGHT HABITS OF *BOLORIA TODDI*

While collecting butterflies along the Beaver River about four miles west of Cedar Falls, Black Hawk County, Iowa, on 3 September 1964, from 12:45 to 1:45 P.M., I made the following observations on *Boloria toddi toddi* Holland. The habitat is an open place in a wooded river bottom which is used as pastureland. Flowers in bloom were: *Helenium autumnale* L. (sneezeweed), *Solidago* (tall goldenrod), *Veronia altissima* Nutt. (tall ironweed), and *Cirsium lanceolatum* (L.) (bull thistle). Trees in this particular spot are a few scrubby *Crataegus* (hawthorn) and *Gleditsia triacanthos* L. (honey locust).

I was investigating *Phyciodes tharos* (Drury) and *Euptoieta claudia* (Cramer), which were quite plentiful, especially on the sneezeweed, when something flew by that looked like a tiny *Speyeria*; I assumed it was a *Boloria*. I tried to capture it but to no avail. However, I was surprised in a few moments to see it or another one fly past again. Then by careful observation, I was able to ascertain that this particular *Boloria* had set up a territory, roughly 100 feet north and south by 500–600 feet east and west. By standing in one spot I found that the butterfly would fly past me periodically. Presently, I discovered that there were two individuals and that both were following the same pattern of flight. Both butterflies circled back and forth in a roughly clockwise motion, east to west, never alighting during the hour-long observation period and never flying very high. The flight was jerky and fast with a circular, zigzag pattern making the butterflies extremely difficult to capture. They eluded the net very easily. Finally, after three quarters of an hour, I managed to capture one of them, a male, and was thus able to identify the species. The remaining one I made no attempt to capture.

The two *B. toddi* paid no attention to the flowers that were in bloom. Occasionally a *P. tharos* that was present on the sneezeweed flowers would rise up to engage in aerial conflict with the *B. toddi* as they flew past, but they did not seem to pay much attention to the apparently aggressive *Phyciodes*. The *Phyciodes* also flew at the *E. claudia* very aggressively.

The two *Boloria*'s were in good condition, with very bright colors, and looked as though they were freshly emerged. According to Klots (1951, *Field Guide to the Butterflies*: 92) this butterfly is double brooded. The two individuals which I observed must have represented the second brood, since they were so fresh late in the season.

This may be a new record for *B. toddi* in the Cedar Falls area, as this is the first time I have observed the species in this area.

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LARVAL FOODPLANT AND DISTRIBUTION NOTES FOR *SCHINIA OLIVACEA* (NOCTUIDAE)

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J. B. Smith (1906) described *Schinia olivacea* from a female taken in October, 1895 at Beeville, Bee County, Texas. The type is in the American Museum of Natural History, New York (Rindge, 1955). Today, this insect remains rare in collections.

Based on collection and rearing records, it appears that *olivacea* is double brooded with perhaps a partial third. It has a pupal diapause. Its flight is from March to November with greatest emergence in June. Of the 49 known examples, all from Texas, 11 were collected in May and 21 in June.

Rearing records

Bexar county, texas: In 1958 three larvae were found eating leaves of *Sida physocalyx* Gray (Malvaceae). The plant was growing on a limestone bluff in the southeastern portion of the Edwards Plateau. The date was recorded on a field label and kept with the larvae. When they died of unknown causes the label was destroyed and the exact date lost. It was not known at that time that these were immatures of *olivacea*. They were, however, distinctive enough to unmistakably remember.

Live oak county, texas: On Texas Highway 9 at La Parra Creek, 12 October 1963, several larvae were found feeding on foliage of *Sphaeralcea lindheimeri* Gray (Malvaceae) growing in the dry, sandy creek bed. Some larvae were parasitized by ichneumonids. The first of four larvae pupated 2 November and a female emerged 20 November 1963. The remaining larvae pupated in due course but remained in diapause until the following year. Adults emerged: 7 June (♂), 8 June (♂), and 15 June (♂).

San patricio county, texas: At the Welder Wildlife Foundation Refuge on 14 September 1963, along a trail near the Aransas River, a few larvae were found feeding on *S. lindheimeri* together with larvae of *Pyrgus communis* (Grote) (Hesperiidae). All the *Schinia* larvae died of parasitism except one which pupated within a day or two; a male emerged 29 September 1963.

Larvae rest on top of the leaves. They are much lighter in color than the foliage, causing them to be conspicuous. The foodplants grow in open areas but may be somewhat hidden by grass or other low vegetation.

Other collection records

André and May Elise Blanchard (*in litt.*) collected most of 39 examples using a black-light trap of a model designed by Mr. Joe P. Hollingsworth, Agricultural Engineer, College Station, Texas. A few, however, came to an 85-watt, high-pressure, mercury vapor lamp set on a white sheet spread on the ground. The date and location of these examples follow.

San Patricio County: Welder Wildlife Foundation Refuge, 22 to 24 August 1962 (6), 11 to 13 May 1963 (10), 3 July 1963 (1), 7 October 1963 (1), and 22 April 1964 (1); Kimble County: V-H Ranch near Junction, 14 June 1963 (2), 28 & 29 June 1963 (10); Uvalde County: Garner State Park, 13 April 1964 (1), 10 May 1964 (1), 1 to 3 June 1964 (5); Zapata County: Zapata, 4 June 1964 (1).

The writer and Mrs. Kendall collected two males feeding on the blossoms of *Mimosa malacophylla* Gray (Leguminosae) about 11:00 A.M. C.S.T. 6 July 1963 at Lake Corpus Christi State Park, San Patricio County. Also, in the same county at the Welder Wildlife Refuge, a female was collected 14 October 1963 at a 15-watt ultraviolet light.

In the American Museum of Natural History is the type female, one other taken by Buchholz at Kerrville, Kerr County, Texas on 8 June 1948 and five of those collected by the Blanchards at the Welder Wildlife Refuge and Junction. In the U. S. National Museum there is one example taken at San Benito, Cameron County, Texas during the period 16 to 23 March; year unknown. In addition, there are three examples collected by the Blanchards at the Welder Wildlife Refuge.

Acknowledgments

The author is very grateful to Mr. André Blanchard for furnishing collection data and encouraging preparation of this paper. Identification of *Schinia* specimens from this study was made by R. R. McElvare, Southern Pines, North Carolina. Special thanks go to Dr. F. H. Rindge (American Museum of Natural History) and Dr. E. L. Todd (U. S. National Museum) for verifying dates of specimens in the museum collections and providing other valued information.

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SOME COMMENTS ON ARIZONA BUTTERFLIES (PAPILIONOIDEA)

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The following records are offered primarily to stimulate additional research on the butterflies of southeastern and east-central Arizona. The author spent his childhood in the foothills of the Santa Rita Mountains south of Tucson and has returned and collected there numerous times in recent years and has regularly visited and collected in the White Mountains of east-central Arizona during the summer months. The author has been reassigned to Brazil and will not be able to continue investigations in Arizona; thus the questions raised by the following data must be answered by others.[1]

The list represents the experience of the author and thus will conflict at certain points with known data (for example, on the abundance of *Speyeria mormonia luski*). The author has not collected at all in the traditionally rich areas of Verde Valley, Mingus Mountain, Yuma, San Francisco Peaks, Grand Canyon, and White Mountains in June. However, it is hoped that the following summary, representing repeated and broad-range collecting in the areas and seasons mentioned, will be of use in stimulating and aiding future studies.

For clarity, nomenclature follows the most recent systematic checklist (dos Passos, 1964).

EXPLANATION OF LIST

The following list, containing the names and data on all of the butterflies observed and/or captured by the author in the areas described, is coded for brevity; for a few species further notation (unusual records, etc.) follows the coded information.

The first figure of each code group represents the region and habitat of the butterfly (Roman numerals I–VI); the second, the season (letters A–D); and third, the frequency (lower case letters). Each code grouping thus describes the occurrence of the species (a butterfly may have several such groupings).

Region and Habitats. I = Southeastern Arizona; desert scrub, streamside, desert watering place; elevation generally below 4,000 feet. Examples: Tucson Country Club; Continental area (particularly along

[1] Further specific data and, in some cases, representative specimens are available for purposes of additional research from the author.

the Santa Cruz River); Desert Corral in the Santa Rita Experimental Range; Sonoita River near Patagonia (also partly habitat II).

II = Southeastern Arizona; foothill canyons, including interdigitations into zone I along watercourses; Upper Sonoran and lower Transition zones; elevation 4,000–6,000 feet. Examples: Santa Rita Ranch Headquarters and hills above; Sawmill Canyon (west slope of Santa Rita Mts.) near Upper Sawmill Well; Florida Canyon (west slope of Santa Rita Mts.) particularly near the Santa Rita Experimental Station; Madera Canyon (west slope of Santa Rita Mts.) below the Lodge; Gardner Canyon (east slope of Santa Rita Mts.); Sunnyside Canyon (west slope of Huachuca Mts.); Miller, Carr, and Ramsey canyons (east slope of Huachuca Mts.); Cave Creek Canyon (east slope of Chiricahua Mts.); Sycamore Canyon (Ruby Road, Pajarito Mts.). This is generally by far the most fruitful collecting habitat, but only a few of the above-mentioned localities will be outstanding in a given year. In the spring season, the grassy hillsides are often better than the canyon bottoms.

III = Southeastern Arizona; mountainsides including upper canyons; generally Transition zone; elevation 6,000–9,000 feet. Examples: Upper Madera Canyon (west slope of Santa Rita Mts.); trails up Mt. Wrightson (Santa Rita Mts.); and Carr and Miller peaks (Huachuca Mts.), from either side of the ranges; road to Onion Saddle and Rustler Park (Chiricahua Mts.).

IV = Southeastern Arizona; mountaintops; generally Canadian and Hudsonian zones; elevation 8,000–10,000 feet. Examples: top of Mt. Wrightson (Santa Rita Mts.); meadows and rocks of the upper parts of the Huachuca Mts.; Rustler Park and above in the Chiricahua Mts.

V = East-central Arizona; White Mountains, moderate elevations; generally Transition zone; elevation 5,000–7,500 feet. North Fork of the White River, from roughly its intersection with the Lower Log Road south of McNary up to the Ditch Camp area; similar conditions are present along the stream near Alpine on the New Mexico border (Route 666).

VI = East-central Arizona; White Mountains, high elevations; Canadian and Hudsonian zones, forest, streamside, and meadow (cienega); elevation 8,000–10,000 feet. Examples: Large cienega area surrounding Green's Peak; Sheep's Crossing, Little Colorado River; wet meadow and forest area on high roads from Green's Peak area to Vernon.

Seasons. A = Spring (generally March and April).

B = Early Rainy Season (generally July to mid-August; specimens caught in September, if any are left, will be very worn).

C = Late Rainy Season (generally mid-August through September; specimens caught in July, if any appear, will be fresh males).

D = General Summer (usually late June through at least October, with a succession of overlapping broods; some fluctuation in abundance during the period).

It should be emphasized that the above seasons are exceedingly variable, being highly dependent upon moisture (date, frequency, and quantity). Collecting in late August, particularly in southern Arizona (in general, the seasons are far more regular in the White Mountains), one could find typical species of either season "B" or season "C," depending upon the major rainy season; and the spring season, which often starts in February, may be delayed well into April in a dry or cold spring. Furthermore, one can collect in season "B" in one canyon and season "C" in another canyon a few miles away, subject to their local precipitation histories. One would do well to inquire locally as to recent rains (number and amount) and do a good amount of traveling in order to find area where the proper combinations have occurred to produce a "good" season. Too little rain results in exceedingly sparse collecting; too much, in difficult collecting due to luxuriant growth of plants and lack of concentration of the butterflies along the watercourses.

Frequencies. a = abundant (over 50 seen in a day's collecting).

c = common (10 to 50 seen per day).

u = uncommon (less than 10 seen per day).

r = rare (a few seen per season).

s = stray (one or a few in many years' collecting).

l = local (restricted to a few favored localities).

i = irregular (numbers fluctuate very widely from year to year, not always correlated with rainfall).

List of Species

Battus philenor (Linnaeus): I-AD-a; II-AD-a.

Papilio polyxenes asterius Stoll: II-D-iu.

Papilio bairdii Edwards: II-D-iu.

Papilio Cresphontes Cramer: I-D-c; II-C-lc.

Papilio multicaudata Kirby: II-D-c; III-D-c; V-D-u.

Papilio eurymedon Lucas: II-D-s. No captures have been made in southern Arizona, but this species has been seen twice: Florida Dam (lower Florida Canyon, west slope of the Santa Rita Mts.), June, 1950, fresh male; and Gardner Canyon (east slope of the Santa Rita Mts.), July, 1951, very worn male.

Neophasia menapia (Felder & Felder): V-B-lic.

Neophasia terlootii Behr: III-B-lu.

Appias drusilla subsp.: II-B-s. A single male specimen, moderately fresh and identical with specimens from central Mexico [*d. drusilla* (Cramer)] in the American Museum of Natural History, was captured at Santa Rita Ranch Headquarters (elevation 4,600 feet) on the northwest slope of the Santa Rita Mts. in August, 1951 (Fig. 1). This may represent a northwestern extreme for the range of this species (although one specimen in the American Museum is labeled "California?").

Pieris sisymbrii Boisduval: II-A-u. All females in the author's collection represent the yellowish form "flava" Edwards; this form also seems to predominate among female specimens from the Rocky Mountain area in the American Museum.

Pieris protodice Boisduval & LeConte: I-D-c; II-D-c; V-D-u; VI-D-u. gen. vern. vernalis Edwards: II-A-lc. The maculation of spring specimens is highly variable, many resembling typical forms of *P. occidentalis* Reakirt; however, all specimens I have seen from or taken in Arizona correspond to *protodice* by recently described criteria (Chang, 1963).

Pieris napi subsp.: V-B-ic. A very heavily marked form.

Pieris rapae (Linnaeus): II-D-lr.

Colias eurytheme Boisduval: II-D-c; III-D-u; IV-D-u; V-D-c; VI-D-u. "hybird" form ariadne Edwards: II-C-u.

Colias philodice Godart: II-C-lc. This species was abundant in the Sulphur Springs Valley, along the west side of the Chiricahua Mts., on 20 September 1963; several forms (Figs. 9–12) were in evidence. Only one specimen from Arizona (Casa Grande, 20 November 1961, R. Sternitzky) is present in the American Museum collection; the author has never seen *philodice* in the State except on the one occasion. Hovanitz (1950) describes the species as being ". . . limited southward by . . . the highlands of the Colorado Plateau in Arizona, and the Valley of the Rio Grande River . . ."; thus this may represent an extension of the known range.

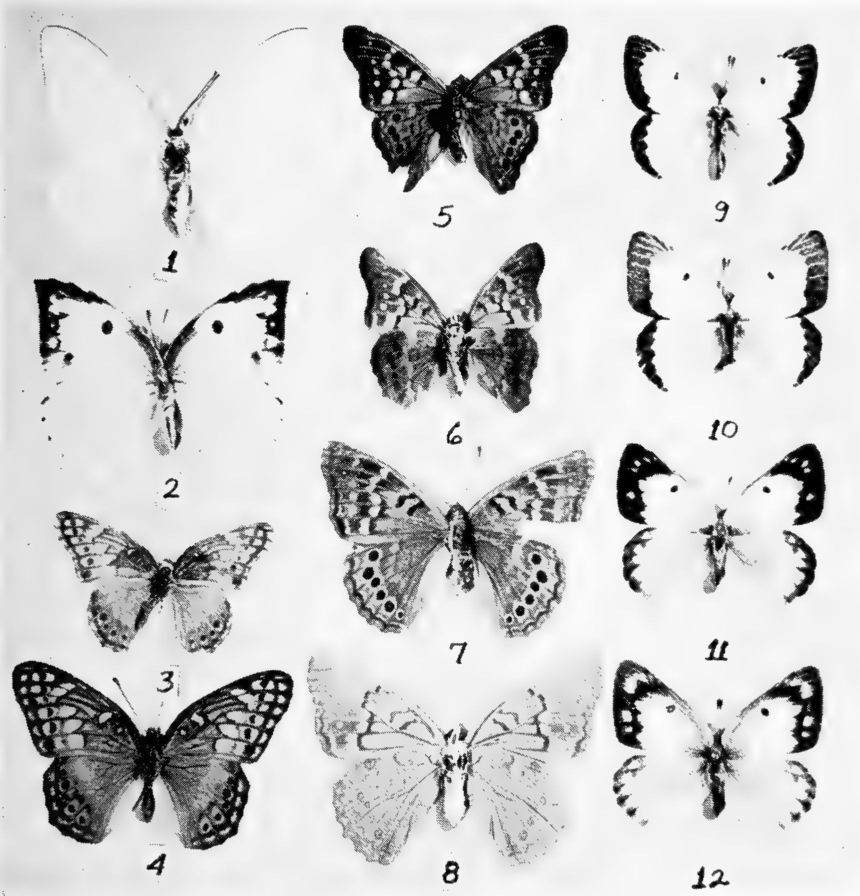
Colias cesonia (Stoll): I-D-a; II-D-a; III-D-u; IV-D-u. ♀ aberration: I-C-s; II-C-s. This variety, resembling the form amorphae (Hy. Edwards) of the more western *C. eurydice* (Stoll), has the markings of the FW above tending toward obsolescence (Fig. 2). (The Antillean and South American subspecies of *cesonia*, *cynops* (Butler), *inca* (Tessmann), seem to show this feature normally in the females.) The author has three captures from Arizona: Green Fields School, northwest of Tucson (elevation 2,100 feet), September, 1950; Florida

Canyon, Santa Rita Mts. (elevation 4,000 feet), September, 1957; and Sunnyside Canyon, Huachuca Mts. (elevation 5,800 feet), 18 September 1963. All of these represent the form rosa M'Neill.

Phoebis sennae eubule (Linnaeus): I-D-a; II-D-a; III-D-c.

Kricogonia lyside (Godart): II-B-ic; III-B-liu.

Eurema boisduvaliana Felder & Felder: II-B-iu.



EXPLANATION OF PLATE

Figs. 1–12. Butterflies collected in southeastern Arizona. 1, *Appias drusilla* (Cramer), Santa Rita Mountains, Aug., 1951; 2, *Colias cesonia* (Stoll), aberration, Sunnyside Canyon, Huachuca Mountains, 18 Sept. 1963; 3, 4, *Euptoieta hegesia hoffmanni* Comstock (3, dwarf, 4, normal), Santa Rita Mountains; 5–8, *Asterocampa subpallida* (Barnes & McDunnough) (5, 6, ♂ upper- and undersides; 7, 8, ♀ upper- and undersides), Santa Rita Mountains; 9–12, *Colias philodice* Godart (9, 10, ♂; 11, ♀ yellow form, 12, ♀ white form), Sulphur Springs Valley, 20 Sept. 1963.

Eurema mexicana (Boisduval): I-AD-a; II-AD-a; III-D-u.
Eurema proterpia (Fabricius): I-D-c; II-D-c. "gen. hiem." gundlachia (Poey): II-C-lc. In favored localities in September, both sexes of this species may be found representing all forms from typical *proterpia* through typical gundlachia. The American Museum collection contains also many such intermediates.
Eurema nicippe (Cramer): I-AD-c; II-AD-c; III-D-u.
Nathalis iole Boisduval: I-D-c; II-D-c; V-D-c.
Anthocaris pima Edwards: II-A-ic.
Anthocaris sara inghami Gunder: II-A-lu.
Euchloe creusa subsp.: II-A-la.
Euchloe ausonides subsp.: II-A-lu. The correct status of the *Euchloe* species in southern Arizona is very uncertain. If one employs the criterion of the angularity of the costal margin of the HW to differentiate between *creusa* and *ausonides*,[2] the vast majority of the specimens are *creusa*. However, this criterion does not correlate well with the more generally accepted criterion of the width of the black bar at the end of the cell of the FW. It would be best to reserve judgment on these forms until better statistical work is available.
Apodemia mormo mejicanus (Behr): II-B-lu.
Apodemia palmerii (Edwards): II-C-lc.
Apodemia nais (Edwards): V-B-c.
Lephelisca nemesis (Edwards): I-C-lc; II-C-lc.
Emesis zela ares (Edwards): II-C-lc. form cleis (Edwards): II-B-lu.
Hypaurotis crysalus (Edwards): III-C-lr.
Atlides halesus (Cramer): II-B-lu.
Mitoura siva (Edwards): II-AB-lu.
Strymon leda (Edwards): I-D-lc; II-D-lc.
Strymon leda ines (Edwards): I-D-lc; II-D-lc.
Strymon melinus subsp.: II-D-c; V-D-c; VI-D-u. Variable; several forms are present in the author's collection from Arizona.
Strymon sylvinus itys (Edwards): II-B-lr; V-B-u.
Callophrys apama (Edwards): V-B-lc.
Lycaena rubidus sirius (Edwards): V-B-c.
Brephidium exilis (Boisduval): I-C-lu; II-C-lu.
Leptotes marina (Reakirt): I-D-a; II-D-a.
Hemiargus ceraunus gyas (Edwards): II-C-c.
Hemiargus isola (Reakirt): I-C-c; II-C-a; IV-C-lc; V-C-c; VI-C-lc.
Lycaeides melissa subsp.: V-C-lu.
Plebejus acmon (Westwood & Hewitson): II-AC-c; V-C-lc.

[2] *E. ausonides* has a more distinct angle. The author thanks O. E. Sette for this useful criterion.

Everes comyntas herrii (Grinnell): V-D-u.
Celastrina argiolus cinerea (Edwards): II-D-u; III-D-lc; V-D-a.
Libytheana bachmannii larvata (Strecker): I-AD-ia; II-AD-ia; III-D-u.
Anaea aidea morrisonii (Edwards): II-D-s.
Asterocampa celtis antonia (Edwards): I-D-u; II-D-u.
Asterocampa leilia (Edwards): I-D-c; II-D-u.
Asterocampa subpallida (Barnes & McDunnough): II-B-lic. The author first captured a worn female of this species in the Santa Rita Mountains (Santa Rita Ranch Headquarters) in September, 1950; this may represent the earliest record outside of the Baboquivaris (Ford, Lep. News, 5: 88, reported the "first individual outside the Baboquivaris" from lower Madera Canyon in September of 1951). At any rate, it is now regular and in some years common at certain favored localities in the Santa Ritas (e.g., the Santa Rita Experimental Range headquarters, in lower Florida Canyon, Figs. 5–8).
Limenitis astyanax arizonensis Edwards: II-D-u; III-D-u; V-D-u.
Limenitis archippus obsoleta Edwards: I-C-lc; II-C-lc.
Limenitis weidmeyeri sinefascia Edwards: V-B-c.
Limenitis bredowii eulalia (Doubleday): II-D-a; III-D-a; V-D-a.
Vanessa atalanta (Linnaeus): II-A-lu; IV-C-lu; V-D-lr.
Vanessa virginiensis (Drury): II-D-lu; IV-D-lu; V-D-u.
Vanessa cardui (Linnaeus): I-D-u; II-D-a; III-D-c; IV-D-la; V-D-c; VI-D-c.
Vanessa carye Hübner: V-B-lr.
Junonia coenia nigrosuffusa Barnes & McDunnough: I-C-lu; II-C-lu.
Nymphalis milberti (Godart): V-D-u; VI-D-u.
Nymphalis antiopa (Linnaeus): II-AB-lu; V-D-c; VI-D-c.
Polygonia satyrus marsyas (Edwards): III-A-lu; V-D-c.
Polygonia hylas (Edwards): V-C-r; VI-C-la. Most specimens resemble *P. faunus* (Edwards) closely; a few (about 15%) possess clear gray undersides, lacking even the silver mark. More work seems to be needed for this species or complex.
Polygonia zephyrus (Edwards): V-D-c; VI-D-lu.
Chlosyne lacinia (Geyer): I-D-c; II-D-la. This includes the various so-called subspecies [*adjutrix* Scudder, *rufescens* (Cockerell), *crocale* (Edwards), *nigrescens* (Cockerell)], which occur sympatrically and intergrade completely.
Phyciodes texana (Edwards): I-D-lc; II-AD-lc.
Phyciodes tharos pulchella (Boisduval): V-B-c.
Phyciodes mylitta (Edwards) (various forms): II-C-lu; IV-C-c; V-D-a; VI-D-c.

Phyciodes campestris camillus Edwards: V-D-a; VI-D-c.
Phyciodes picta Edwards: I-C-c; II-C-lc.
Melitaea dymas chara Edwards: II-AD-a.
Melitaea perse Edwards: II-D-a.
Melitaea theona thekla Edwards: V-D-lc.
Melitaea theona bollii Edwards: I-C-lu.
Melitaea pola arachne Edwards: V-D-c.
Euphydryas anicia magdalena Barnes & McDunnough: V-B-lu; VI-C-lc.
Speyeria n. nokomis (Edwards): V-C-lc.
Speyeria nokomis coerulescens (Holland): III-C-lu. The author ran across a colony of this subspecies while on a pack trip in the upper Huachuca Mts. in August, 1950 (unfortunately *sans* net); both sexes were observed within five feet. An attempt to relocate the colony in 1963 was fruitless; the general area is in a spring-fed meadow near the top of Sunnyside Canyon.
Speyeria atlantis nausicaa (Edwards): V-B-a; VI-D-u.
Speyeria mormonia luski (Barnes & McDunnough): V-C-lr.
Speyeria aphrodite byblis (Barnes & Benjamin): V-B-c.
Euptoieta claudia (Cramer): I-D-c; II-D-c; V-D-u.
Euptoieta hegesia hoffmanni Comstock: II-B-lir. This species seems to be rare in southeastern Arizona. Both the typical form (Fig. 4) and the dwarf form (Fig. 3) may be captured; the latter corresponds to a series in the American Museum labeled "Sonora," while the former is identical with a series labeled "Flagstaff, Arizona," which, if it is labeled properly, must have been captured in a truly extraordinary year. The author's specimens were taken in the early 1950's at the Santa Rita Ranch Headquarters in the Santa Rita Mountains.
Agraulis vanillae (Linnaeus): I-D-c; II-D-c.
Danaus plexippus (Linnaeus): I-C-c; II-C-c; V-D-u.
Danaus gilippus strigosus (Bates): I-D-a; II-D-a; V-D-u.
Euptychia dorothea (Nabokov): II-B-lu; III-B-c.
Euptychia henshawi Edwards: II-C-c; III-C-a.
Euptychia rubricata Edwards: II-B-u; III-B-c.
Paramecera xicaque (Reakirt): III-B-lu.
Cercyonis pegala olympus (Edwards): V-B-lu.
Cercyonis oetus (Boisduval): V-B-c.
Gyrocheilus patrobas tritonia (Edwards): II-C-ic; III-C-c; V-C-lc. This species was common along the North Fork of the White River in the area south of McNary in early September, 1963. The form captured tends to possess appreciably more blue in the marginal markings on the HW underneath than average specimens from southeastern Arizona, al-

though there is some overlapping and the difference should be analyzed statistically (perhaps with the aid of a spectrometer). It would also be interesting to compare this type, presumably from the northeastern extremity of the butterfly's range, with specimens from the Prescott area, presumably the northwestern extremity (and rather different from the White Mountains in climate).

Acknowledgments

The author is indebted to the American Museum of Natural History, and particularly to F. H. Rindge and J. C. Pallister, for assistance in work in the fine collection housed therein; and to O. E. Sette and P. R. Ehrlich for additional assistance in this report.

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A NEW TECHNIQUE FOR SPREADING MINUTE MOTHS

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For many years glass tubes containing cyanide have been used for killing small moths. These were experimentally replaced with plastic ones in order to reduce the danger of breakage. It was noted, however, that in the plastic tubes minute moths were forcibly drawn to the sides by static electricity, and held there until death. After death there was no static electric attraction, but many of the scales were left adhering to the tube, and spoiling the specimens. Because of this disadvantage I no longer use plastic tubes for killing.

With this static electric attraction in mind, a special spreading board was designed. The board (Fig. 1) consists of a solid piece of one-inch lumber, 2¼ inches wide and 12 inches long. The top is rabbeted along each side to a width of one-half inch and a depth of one-eighth inch. A strip of cork is glued in the rabbet on each side. Another strip of cork is glued to the bottom, flush with all edges of the board. A strip of "Plexiglass," one-inch wide and one-sixteenth inch thick is glued to the top of the nonrabbeted center portion of the board. Before it is glued onto the board, the plastic strip is sawed for three-quarters of its width at intervals

of one inch. The saw kerf should be about one mm wide. After the plastic is glued to the board, holes are drilled in the center of each saw kerf through the wood, but not through the cork lining the bottom. This hole is almost as wide as the saw kerf and allows the insect pin to be inserted in the cork at the bottom of the board.

To use this spreading board, the little moth is slightly anesthetized in a tube containing acetic ether. It is immediately pinned through the center of the thorax (usually a No. 000 pin). It is important that the pin be inserted absolutely perpendicular to the longitudinal axis of the moth's body. Because the moth is not dead the muscles are relaxed, and the wings can be gently blown from behind with a puff of breath, until they are semispread. The pin is then inserted through the hole and into the cork at the bottom of the board. Because the moth is alive, static electricity causes the wings and antennae to adhere to the plastic. The wings and antennae are now manipulated into the correct position using a No. 000 insect pin. The point of the pin is not inserted in the wings but is used to push the wings into place by inserting it under the trailing edge of each wing near the body. When the wings are in the right position, a strip of thin cellophane is placed over them on each side of the body, and the ends of each strip are pinned to the cork at the sides of the board. The moth is now killed by placing the open end of an uncorked killing tube, containing acetic ether in cotton, over the moth and leaving it there a minute or two until the moth is dead. The static electric attraction is now gone, but the cellophane strips hold the wings in place until the moth is removed from the board.

This technique is particularly suitable for narrow-winged moths with long fringes, such as Gracillariidae, Lyonetiidae, Coleophoridae, Nepticulidae, and Tischeriidae.

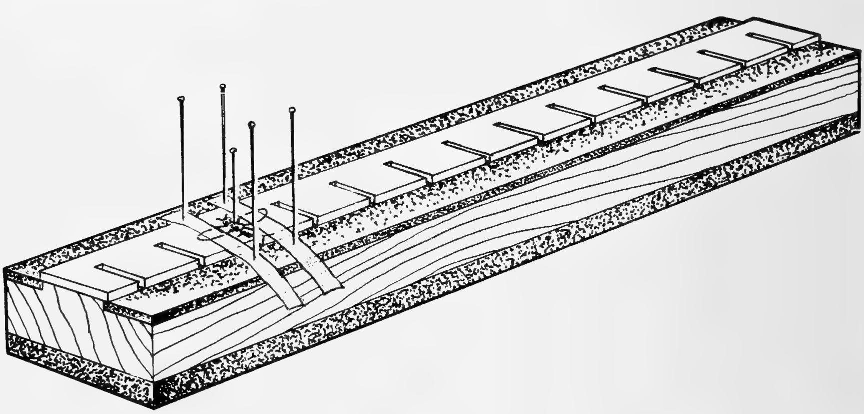

Fig. 1. A new type of spreading board for minute moths.

MICROLEPIDOPTERA PALAEARCTICA

EDITOR'S NOTE.—Announcement of one of the most ambitious projects in the history of the study of Lepidoptera, the projected series *Microlepidoptera Palaearctica*, has recently been made by Dr. H. G. Amsel of the Landessammlungen für Naturkunde, Karlsruhe, Germany. The following English translation of the preface to the work is presented in order to acquaint lepidopterists throughout the world with the scope and aims of this magnificent project.

According to present plans, the various families of Palearctic Microlepidoptera will appear in no fixed order or succession. Families or subfamilies will each be published as a volume, to be prepared as authoritative specialists are available. The first volume comprises Dr. Bleszynski's monograph of the Crambinae, consisting of some 800 pages of text, about 890 text figures, and 444 colored figures. Volume 2, scheduled for publication early in 1965, will contain Dr. Sattler's study of The Ethmiidae. A treatment of the Tineidae by Dr. Petersen is projected as the third volume in the series.

Persons desiring further information or wishing to subscribe to the work should contact Dr. Amsel, or Verlag Georg Fromme & Co., Spengergasse 39, Vienna 5, Austria.

PREFACE

The death of Edward Meyrick in 1938 was a turning point in the study of Microlepidoptera, signifying more than the passing of a famous and respected author. In 420 publications Meyrick had described some 16,000 species of Microlepidoptera, thereby putting in the shade, from a purely numerical point of view, the descriptive work of any single person in the biological sciences. His breadth of scope was as amazing as the volume of his work: he alone envisaged the Microlepidoptera Fauna of the entire world, of which he formed a single collection numbering about 100,000 specimens, and in most cases his sure eye pointed the right way. But already during his lifetime it had become clear that the science of Microlepidoptera would enter a blind alley sooner or later unless new methods of study were found. The volume of new description increased to such a degree that gradually the comprehensive mastery failed, which at the beginning of our century still resided in a few such brains as Meyrick, Walsingham, and Rebel, and it became clear that, more exact, and indeed, in some groups, extremely refined methods of investigation were already in use, so in Microlepidoptera too a completely new system need be developed.

Although at the turn of the century authors were still to some extent able to work generally and independently, the volume of the literature and material made obligatory a strong specialisation, which naturally led to co-operation. The methods which are now scientifically requisite intensified this process, if only because of the time involved. But the decisive step forward was made when the value of the genital morphology was appreciated as being of fundamental importance. From year to year it became more generally recognised that the current method of taxonomic

work was not merely inadequate but must inevitably lead to incomprehensible chaos. Meyrick's view that a species could be so clearly described that it could be recognised from the description of the external features proved to be a serious error. Numerous species can only be distinguished in the morphology of their genitalia, and indeed the depiction of the genitalia almost always provides the truly unambiguous method of recognising a species. In particular the works of many authors, which have appeared since World War II, have shown that systematic revisions of groups furnished a quite new picture of the situation. For instance, Petersen established, in the relatively small Palearctic Tineidae group, the existence of sixty synonyms, and made such generic changes that hardly one stone of the old system remained on another. In the Crambinae, a comparatively small subfamily of the Pyralidae, Bleszyński proved that sixty-seven species, from various regions, belonged to quite different subfamilies or even families, and also established countless synonymies.

In view of this situation, the present author was forced more and more to contemplate a new and fundamental work on the Palearctic Microlepidoptera, and his decision to publish "Microlepidoptera Palaearctica" was reached nine years ago. After protracted negotiations with authors, publishers, and scientific institutes, it was finally possible to overcome the almost insuperable difficulties in the path of this undertaking. Not the least among the reasons for this final success was a particularly favourable combination of circumstances such as have rarely occurred in biological literary history. Never before was so large a number of internationally outstanding specialists of East and West available simultaneously to undertake such a task; never before had there been a Microlepidoptera-specialist such as Dr. Gregor, combining the highest scientific and artistic qualifications; seldom, too, had a publishing firm been prepared to issue so comprehensive a work, at the same time so specialised and so wide in scope, and with the barest prospects of profit; never before had the happy circumstance occurred, to find as a leader of a great and capable printing works such a person as H. Reisser, who being himself an experienced lepidopterist, was delighted to give his personal and unremitting attention to such a project. Finally, both the German Exploration Corporation and the Baden-Württemberg Ministry of Culture evinced an extraordinary comprehension for our efforts and enabled the almost insuperable financial difficulties to be overcome. Many others played a valuable role, but it would take too long to mention them all by name.

At the XIth International Congress of Entomology at Vienna the meeting of a large number of contributors to "Microlepidoptera Palaearctica"

was first possible, and the plotting of the general scheme which the enterprise was to follow. This scheme was the subject of further prolonged correspondence, with the following result:

1. All scientific work on the Palaearctic Microlepidoptera will be co-ordinated into the framework of "Microlepidoptera Palaearctica"; such co-ordination has hitherto been lacking, and this lack was one of the main causes of the present impossible situation in the systematic field. In the course of this co-ordination, individual authors will be enabled to work through respective groups as represented in the greatest museums and also the principal European private collections.

2. The study of each species will begin with an examination of the type specimen or series.[1] Specific determinations, hitherto made on the sole basis of literary studies have often led to the most grotesque mistakes. An investigation of types will provide an indisputable proof of what is really meant by a described species. The synonyms and uncertain species can be compared and their identity resolved, thus providing a sober foundation for all future scientific work. All purely compilatory work is to be avoided; instead all conclusions will rest on material that has been currently investigated.

3. In order to achieve the indisputable identification of all the species, the study of each one will begin with the establishment of the genitalia-morphology of both sexes, with due regard to all the characters of systematic value. Black and white drawings of the genitalia, coloured reproductions of water-colour drawings of the right side, made from the actual specimens, with pictorial representation of systematically important details (e.g. neuration, antenna, frons, or palp-formation) should provide a maximum of comprehensibility. Vague uncertain statements about the palp-form antenna-ciliation, or cornutus-length, such as "end segment of palpus long" will be replaced by unambiguous statements, e.g. the length of the third segment will be related to that of the second, and the length of the entire palp to the diameter of the eye, thus: "3 palp-segment, ⅓" means that the last segment is one third the length of the second; and "palp 3" means that the palp is three times as long as the diameter of the eye. Likewise for the antenna-ciliation, "antenna ciliation 2" means that the cilia are twice as long as the breadth of the antenna shaft, relating the longest cilia to the broadest part of the shaft. Similarly, "cornutus 1" means that the cornutus is as long as the aedeagus. Thus even a beginner will be enabled to work in a new field of study: and institutes of applied entomology will be provided with a rapid means of orientation.

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[1] As far as ascertainable, the data of the labels of the types will be quoted *verbatim* with a special indication at the relevant place of the work.

4. The clearing up of synonymies and systematic errors will result in the final termination of nomenclatorial chaos. We urgently need durable names, names that will remain valid for all time. By applying paragraph 23b of the International Rules of 1961 for Nomenclature, the preservation of established names can be achieved, and the principles of Priority and Continuity can be intelligently combined. Such a result is of great importance, especially for applied entomology.

5. The specific description will be as brief as possible, and preferably should give what the illustrations leave out, e.g. variability, comparison with neighbouring forms, and stressing of the diagnostically important characters. Data regarding larvae and imagines' phenology and ecology, foodplants, and biological peculiarities, are part of the description of the species. On the other hand, the larva will not be described, as such descriptions are only of use if scientifically exact, that is if they not only give the chaetotaxy but illustrate it too. As the larvae of 90% of all Palaearctic Microlepidoptera are still unknown, only a reference to the literary sources for the chaetotaxy of such larvae as are known, need be given. An exception, however, may occasionally be made to this rule (e.g., economically important species).

6. Neuration indications should follow the Comstock system, with a subdivision into Costa, Subcosta, Radius, Media, Cubitus, Analis and Axillaris. The technical terms for genitalia-parts are so different from group to group, and the question of homologies, etc., so disputed, that a special explanation should be given for each systematic group.

7. Distribution data will be given after the specific description, all countries and districts being named from which the author has seen material, and special value being accorded to the limits of the distribution, and also, in disjunct ranges, to the accurate definition of the localities inhabited. These data will thus definitely be reliable. The author may then add the names of the countries in which he knows of the occurrence of the species from literature only, and only in these cases need the references be cited. Doubtful literary records can be marked with a "?", or a critical remark. Localities will be rendered as given in the literature and specimen-labels, for instance the name Sarepta will be given rather than Krassnoarmejsk. Political conceptions, of which the boundaries vary more or less according to the political developments, should as far as possible be avoided and replaced by geographical conceptions. The general zoogeographical heading will, in principle, contain only verified facts about the distribution of the species, genera, or groups; as a consequence, there should be no reference to faunistic elements, and similarly the probable origin of the species should not be discussed as most publi-

cations about such are more or less speculative. The aim of "Microlepidoptera Palaearctica" is to provide only indisputable scientific facts.

8. The principles mentioned under 1 & 7 above will greatly simplify the problems of literary citations. It is evident that the method hitherto often used, of mentioning the entire literature on any one species, is superfluous, as it occupies much too much of the author's time and takes up too much space. It is now sufficient to give the original citation, followed by the synonyms, and thereafter only such references *as provide more information than will be found in the text or the illustrations of "Microlepidoptera Palaearctica"*. For instance, such additions might be the illustration of the species in its resting position, biological data, chaetotaxy, illustrations of mines, pattern of eating, etc. On the other hand, if an imago is somewhere illustrated or described in the usual way, it is superfluous to cite the reference, as the "Microlepidoptera Palaearctica" illustrations are at least as good as any previous figure. Superfluous too are all references to the distribution of a species, if the author, on the basis of his own studies, is able to give the same information. For individual species, only a minimum of prior literature need be cited to supplement any gap in the data provided. The alphabetical general literary index at the end of every volume, on the other hand, should in addition give the reader a view of previous literature and at the same time indicate what the author has found especially valuable as a source.

9. In order to avoid the possibility that any author might overlook something which already appears in literature, the editor is pleased to put his own card-index at the disposal of all collaborators. This covers all literature since 1901, i.e. since the appearance of Rebel's Catalogue of the Lepidoptera of the Palaearctic Region. The possibility will thus be virtually ruled out that any important literary source will be overlooked.

10. Determination keys for the genera and species will guide the reader downward to the species, but in certain cases, when it has been proved that a systematic unit cannot intelligently be forced into any key, these may be omitted.

11. In accordance with the recommendations of the International Commission for Nomenclature, all abbreviations of authors' names will be avoided. Abbreviations will only be used as a distinctive mark in the Indices and Tables. In the course of the systematic text authors' names will be entirely omitted, except where this would cause obscurity.

12. Every specimen painted by Dr. Gregor will be distinguished with a label "Painted by Dr. Gregor for Microlepidoptera Palaearctica", as in future it will be useful to know which specimen served as a model for the published picture. The data of all such examples will be given in the explanation of the plates, and particularly the place of custody. In prin-

ciple, the typical series will provide the specimens used as models for the painter. In cases, however, where, owing to poor preparation or preservation, the type by itself does not suffice for the satisfactory reproduction of the appearance of the species, the painting may be adjusted for esthetic reasons, as long as this does not involve scientific inaccuracy. Here particularly, in cases where an abdomen is missing, the artist may add the missing part, observing the correct proportions by reference to the holotype and other typical material. In all cases where such a procedure was necessary, the fact will be mentioned in the explanation of the figures.

13. In order to show as exactly as possible all the individual characters, the coloured illustrations of the moths are reproduced on a scale larger than life-size. However, in order to show the relative size of congeners, species belonging to the same genus will be, as far as possible, shown on the same scale. The actual scale will be indicated in the explanations of the plates. Deviation from this rule, however, could not be avoided in a few cases for various reasons, and where this occurs the figure in question is always marked with an indication of the variant scale of magnification. The scale mainly used for the genitalia illustrations, being that suitable for most of the drawings, is stated on the intermediate titles before the genitalia plates. If a few figures deviate particularly from the general scale of enlargement, this is indicated beside the figure in question.

It is well-known that the scale of enlargement is fairly unimportant in genitalia illustrations because the preparations are usually examined at different powers of magnification.

14. Limits of the Region. The following districts will be the Regional frontiers: Canary Is., Madeira, Iceland, Sahara and Arabia as far as about latitude 20 N, West Pakistan as far as and including Karachi, the High Himalayas down to about 3,000 m, the Yangtse-Kiang and Japan. Disputed frontiers such as Sikkim, Bhutan, or the further Chinese frontier, may be entirely included or excluded. For instance, if a tropical genus is only represented by one species in Sikkim, it may be omitted, but all species in Sikkim belonging to Palaearctic genera will be included. In many cases the inclusion or exclusion will be at the author's discretion. In districts with distinctly more than 50% Palearctic species, all species occurring should be included, even including the tropical species. Where, on the other hand, a transitional area has distinctly less than 50% Palearctic species, all tropical species will be omitted. The south border of the Sahara appears to be partly inhabited by Palearctic species, and parts of Arabia far south of the tropic seem likewise to be Palearctic. The boundary is for that reason fixed at 20 N latitude, while in the East Asiatic region the boundary will be distinctly further north, being far less distinct and more complicated than in the African-Arabian region.

15. The work will consider all Monotrysian lepidoptera as Microlepidoptera, with the sole exception of the Hepialidae, which have been already studied in the works dealing with the Palearctic Macrolepidoptera. In addition all Ditrysian families usually considered the Microlepidoptera, and so treated in the Rebel 1901 Catalogue, will be included, with the addition of the Psychidae. This addition is made because in this family particularly, the division between Macro- and Microlepidoptera has had the most unfortunate results. Furthermore, a new work dealing with the Microlepidoptera will doubtless lead to general changes of views on systematic definitions. But as the new picture of the systematic definitions will only emerge after a decade or two, it is best to continue for the present with the usual division into Macro- and Microlepidoptera, despite its being scientifically unsatisfactory.

16. Numbering and other references will be made on a system that will reduce the need to refer to indexes considerably, and so greatly lighten the task of any reader using the work.

17. As the work will appear in German, each part will be preceded by a table giving the most important recurrent technical expressions with their meanings in English, French and Russian. We are convinced that this will enhance the international usefulness of the work.

18. An alphabetical list of the less-known localities and geographical terms, and a general map of Central and Eastern Asia, will be given to assist geographical orientation.

With the above aims, we hope to give a new impulse to microlepidoperology; we believe that not only will "Microlepidoptera Palaearctica" be a revision of all that exists in this field of science, whether in literature or collections, but we are convinced above all that a sure foundation will be laid down for all future work in this field. We anticipate further through this work and the application of its principles, microlepidopterology will achieve a new power of attraction which will lead to a deepening and widening of our fair science. To this the water-colour drawing of Dr. Gregor especially will contribute, constituting a unique event in entomological history. Not only might one say of them what was said of the great models of Ter Meer, that each drawings is at one and the same time both type and individual, but the drawings are, in most cases a first documentation of an unprecedented kind. Text and illustration merge to form an unity, serving to open to a wider public what threatened to become an obscure and specialised corner of the entomological field. At present it is virtually necessary for one specialist to concentrate on one taxonomic group, and we find but one worker qualified to determine the species of that group, with the result that there is but one person to whom

to entrust all material of that group for determination. Hereafter, however, this state of affairs will undergo a radical improvement, at least as far as concerns the Palearctic Microlepidoptera. Every entomologist capable of scientific work will be able relatively quickly to determine his own material. The separate volumes of "Microlepidoptera Palaearctica" will enable him to find his way with speed and accuracy, and will also be of particular assistance to all branches of applied entomology. The works in this field have hitherto been grievously hampered by the want of a simultaneously organised systematic reference work; by the constant changes of nomenclature, and the impossibility, without reference to specialists, of determining the pests with which they are dealing. But this case will cease to be so, owing to the remarkable clarity of "Microlepidoptera Palaearctica" with its combination of coloured figure of imago, black and white drawings of all important morphological details, and text summary of the facts.

The publication of the first volume of this work marks the completion of the first step towards this scientific goal, and I feel a particular need to thank all those who have served in this enterprise. First and foremost I thank all my colleagues who joined me in launching the project and provided the prerequisite conditions for the co-ordination which the work will evince. The decision to proceed with this enterprise fell lightly on none of us, as in most cases it amounted to an obligation extending over many years, indeed in many cases for a whole decade, or in the case of Dr. Gregor, for a whole life-time. To him therefore are due the greatest and deepest thanks; without him "Microlepidoptera Palaearctica" would have been unthinkable. Further I thank Herr Hans Reisser of Vienna, whose great and many-sided initiative and practical counsel on many matters helped the work forward, and who, for his part, obtained the consent of publishers George Fromme & Co. to publish it. I thank the publishers for their great understanding and also for the care devoted to the printing and setting up of the work; in such an enterprise this is of the utmost importance. In particular I wish to express my gratitude to Professor Carl Wurster of Ludwigshafen, who devoted his constant efforts towards the success of the project. Without him, it must be duly said, it would not have been possible to overcome all the difficulties involved in the planning of so great and unusual a work. "Microlepidoptera Palaearctica" can consequently be said to be his work too. Mr. Kurt Schäfer of Ludwigshafen, Professor Martin E. Hering of Berlin, Dr. Walter Forster of Munich, Dr. Obraztsov of New York, Messrs. Charles Boursin of Paris and E. P. Wiltshire of Geneva, and my friend Dr. E. Oberdorfer, Director of the Museum of Natural History at Karlsruhe, have all stood by my side and assisted me.

Dr. B. Rossicky of Prague was also of great assistance to our enterprise; and lastly, the German Institute of Exploration and the Baden-Württemberg Ministry of Culture gave from the outset such support to all our efforts that finally the foundations of the work were successfully laid with the issue of the present Volume I. My greatest thanks to all!

H. G. AMSEL, Landessammlungen für Naturkunde, Erbprinzenstrasse, 13, (75) Karlsruhe, Wien

ANOTHER U.S. RECORD FOR *OENEIS MACOUNII*

On 20 June 1964 Dave Pearson, Ray Glassel, and I were collecting in Lake and St. Louis counties, Minnesota. We stopped at McNair, Lake County (about 20 miles north of Two Harbors), to look for red-disked alpines, *Erebia discoidalis* (Kirby), a species we had caught there about a month earlier. The morning was cool and sunny but no alpines were seen.

The first butterfly we saw was sitting on a rock, inclined toward the sun, and thus casting very little shadow. We quickly captured it and another one nearby which was behaving similarly. Both were typical Macoun's arctics, *Oeneis macounii* (Edwards). Macy and Shepard (1941)[1] list the only Minnesota specimen as having been taken 2 July 1935 near Duluth, St. Louis County. We thus have the second Minnesota record. Ehrlich and Ehrlich (1961)[2] list only Minnesota and Michigan as the U.S. localities for this species. The Michigan record is most likely the Isle Royale record cited by Macy and Shepard. Therefore we suspect that we may have the third U.S. record for *Oeneis macounii*. Since Isle Royale is much closer to Minnesota than to Michigan, this species seems to occur in a very limited area in the U.S., just above the north shore of Lake Superior. We currently think of northern Minnesota as relatively uncollected for insects and one of our projects will be to try to establish the exact status of this and other "rare" species in the near future.

RONALD L. HUBER, *480 State Office Bldg., St. Paul, Minnesota*

[1] Ralph W. Macy & Harold H. Shepard, *Butterflies* (Minneapolis: University of Minnesota Press, 1941), p. 87.
[2] P. R. Ehrlich & A. H. Ehrlich, *How to Know Butterflies* (Dubuque: Wm. C. Brown Co., 1961), p. 102.

RECENT LITERATURE ON LEPIDOPTERA

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here. Papers of only local interest and papers from this *Journal* are listed without abstract. Readers, not in North America, interested in assisting with the abstracting, are invited to write Dr. P. F. Bellinger (Department of Biological Sciences, San Fernando Valley State College, Northridge, California, U.S.A.). Abstractor's initials are as follows:

[P.B.] — P. F. Bellinger	[W.H.] — W. Hackman	[N.O.] — N. S. Obraztsov
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B. SYSTEMATICS AND NOMENCLATURE

Munroe, Eugene, "Pyralidae from the collection of the California Academy of Sciences (Lepidoptera)." *Canad. Ent.*, 91: 161–167, 14 figs. 1959. Describes as new *Desmia filicornis* (Potrerillos, Panama); *Mecyna cocosica* (Cocos Is.); *Polygrammodes naranja* (17 mi NW of Tepic, Nayarit, Mexico); *CALLILITHA*, & type *C. boharti* (Tenaru R., Guadalcanal, Solomon Is.), *C. tenaruensis* (same). [P. B.]

Munroe, Eugene, "Revision of the genus *Linosta* Möschler (Lepidoptera: Pyralidae) with characterization of the subfamily Linostinae and a new subfamily." *Canad. Ent.*, 91: 485–488, 7 figs. 1959. Proposes CYBALOMIINAE (near Crambinae) & LINOSTINAE. Describes as new *L. annulifera* (Oconeque, SE Peru, 7,000 ft), *L. sinceralis centralis* (Finca "La Violeta," Soconusco, Chiapas, Mexico, 850 m), *L. s. andina* (Balzapamba, Prov. Bolivar, Ecuador), *L. s. plaumanni* (Nova Teutonia, Sta. Catharina, Brazil). Redescribed *L. s. sinceralis*, the only other form known. [P. B.]

Munroe, E. G., "The *phlogosaria* complex of the genus *Plagodis* (Lepidoptera: Geometridae)." *Canad. Ent.*, 91: 193–208, 3 pls. 1959. Describes as new *P. p. bowmanaria* (Edmonton, Alberta), *P. p. illinoiaria* (Edgebrook, Illinois). *P. purpuraria* & *P. keutzingaria* are regarded as sspp. of *P. phlogosaria*; the other valid sspp. are *approximaria* & *iris*. Spring & summer broods are described & numerous collection records are given. 63 specimens are figured on the plates. [P. B.]

Munroe, Eugene, "A new genus of Pyralidae and its species (Lepidoptera)." *Canad. Ent.*, 92: 188–192, 8 figs. 1960. Describes as new *COENOSTOLOPSIS* (type *Coenostola? apicalis* Lederer), *C. terminalis* (Rio Yapacani, E. Bolivia, 600 m). Redescribes type, & *C. selenephora* (transferred from *Phryganodes*). [P. B.]

Munroe, Eugene, "An assessment of the contribution of experimental taxonomy to the classification of insects" [in English; French summary]. *Rev. canad. Biol.*, 19: 293–319. 1960. Review shows that only the most elementary experimental techniques (e.g. association of sexes, forms, and stages by rearing) have been widely used, and that the use of cytological, physiological, and other nonmorphological criteria is in its infancy, even in such groups as *Drosophila* which have been studied intensively. [P. B.]

Munroe, Eugene, "New species of *Polygrammodes* and a related new genus (Lepidoptera: Pyralidae)." *Canad. Ent.*, 92: 279–284. 1960. Describes as new *P. zischkai* (Yungas del Palmar, 200 m, Bolivia), *P. delicata* (Esmeraldas, San Mateo, Ecuador), *P. lauei* (Tecualpan, Mexico), *P. mimetica* (Barro Colorado Is., Pan-

ama Canal Zone); *POLYGRAMMOPSIS* (monobasic), *P. forsteri* (Esmeraldas, Ecuador). [P. B.]

Munroe, Eugene, "New tropical Pyraustinae (Lepidoptera: Pyralidae)." *Canad. Ent.*, 92: 164–173, 16 figs. 1960. Describes as new *Glyphodes aurantivittalis* (Fort de Kock, Sumatra); *Diaphania antillia* (Kenscoff, Haiti); *Botyodes borneensis* (Mt. Kinabalu, Borneo); *HEDYLEPTOPSIS* (monobasic), *H. flava* (Tonsea Lama, Tontano Menado, N. Celebes); *Typsanodes celebensis* (Minahassa, N. Celebes); *Agathodes transiens* (Puente Villa, Yungas, Bolivia, 1,200 m); *Syngamilyta nympha* (Rio Yacuna, Espiritu, 250 m, Bolivia). [P. B.]

Munroe, Eugene, "The Meyrick types of Scopariinae (Lepidoptera: Pyralidae) in the British Museum (Natural History), exclusive of Hawaiian species." *Canad. Ent.*, 92: 891–897. 1960. Lists all holotypes & selects lectotypes for other spp., giving citation & label description. [P. B.]

Munroe, Eugene, "Synopsis of the North American Odontiinae, with descriptions of new genera and species (Lepidoptera: Pyralidae)." *Canad. Ent.*, suppl. no.24, 93 pp., 246 figs. 1961. Describes as new: *Microtheoris ophionalis lacustris* (Harrow, Ontario), *M. o. eremica* (Limpia Canyon, Jeff Davis Co., Texas), *M. o. baboquivariensis* (Baboquivari Mts., Arizona), *M. o. occidentalis* (Oliver, British Columbia); *RHODACANTHA*, & type *R. diagonalis* (Alamogordo, Otero Co., New Mexico); *FRECHINIA* (type *Titanio helianthiales*), *F. texanalis* (Ft. Davis, Jeff Davis Co., Texas); *PROCYMBOPTERYX* (type *Pionea belealis*); *CYMBOPTERYX*, & type *C. fuscimarginalis* (Tucson, Arizona); *DICHOZOMA* (type *Loxostege parvipicta*); *CUNEIFRONS*, & type *C. coloradensis* (Moffat Co., Colorado); *ANATRALATA* (type *Aporodes versicolor*); *POGONOGENYS* (type *Titanio proximalis*), *P. frechini* (Vantage, Washington), *P. masoni* (Whitewater, Calif.); *PLUMIPALPIA*, & type *P. martini* (Dove Sprs., Kern Co., Calif.); *NANNOBOTYS* (type *Botis commortalis*); *PORPHYRORHEGMA*, & type *P. fortunata* (Fish Creek Mts., Imperial Co., Calif.); *PSAMMOBOTYS*, & type *P. fordi* (Sand Dunes, El Segundo, Los Angeles Co., Calif.); *JATIVA* (type *Orobena castanealis*); *PSEUDOSCHINIA* (type *Eurycreon elautalis*); *NOCTUELIOPSIS* (type *Noctuelia puertalis*); *MOJAVIA* (type *Noctuelia achemonalis*); *HELIOTHELOPSIS* (type *Aporodes arbutalis*). The subfamily includes tribes Dichogamini & Odontiini, with, respectively, 3 and 19 nearctic genera; at least 56 extralimital genera are not treated here. Keys to genera & spp. [P. B.]

Munroe, Eugene, "The classification of the Papilionidae (Lepidoptera)." *Canad. Ent.*, suppl. no.17, 51 pp. [1961]. Describes as new *PROTOGRAPHIUM* (type *Papilio leosthenes*). Recognizes the subfamilies Baroniinae (monobasic), Parnassiinae, including Parnassiini (3 genera) & Zerynthiini (5 genera), and Papilioninae. The typical subfamily includes Leptocircini (7 genera; the "kite swallowtails" plus *Lamproptera* & *Teinopalpus*), Papilionini (a single genus, with sections but no subgenera), and Troidini (6 genera). All groups are defined, and important characters are discussed, including some which will be useful when known for more spp. All known spp. are assigned to genera, at least tentatively, in an appendix. [P. B.]

Munroe, Eugene, "A new species of *Linosta* (Lepidoptera: Pyralidae)." *Canad. Ent.*, 94: 922–923, 2 figs. 1962. Describes as new *L. integrilinea* (Heda-Taulis, Peru). [P. B.]

Munroe, Eugene, "A new species of *Nepytia* (Lepidoptera: Geometridae), of economic importance to Douglas Fir in British Columbia." *Canad. Ent.*, 95: 407–413, 25 figs. 1963. Describes as new *N. freemani* (Chase Creek, B.C., Canada); key to spp. of *N. canosaria* group. [P. B.]

Munroe, Eugene, "The *gilvarius* group of *Aspilates* Treitschke (Lepidoptera: Geometridae)." *Canad. Ent.*, 95: 260–287, 56 figs. 1963. Describes as new *A. kozhantchikovi* (Minusinsk, Siberia), *A. aberratus assiniboiarius* (Attons Lake, Cut Knife, Saskatchewan, Canada), *A. forbesi* (Churchill, Manitoba), *A. elwesi* (SE Altai, Tchuja Mt., 7,000 ft), *A. orciferarius baffinensis* (Frobisher Bay, Baf-

fin Is.), *A. o. churchillensis* (Fort Churchill, Manitoba), *A. o. occidentalis* (Dawson, Yukon, 11,000 ft). Revision of the 13 spp. of this holarctic group, with key to spp. [P. B.]

Munroe, Eugene, "Some neotropical genera resembling *Epicorsia* Hübner (Lepidoptera: Pyralidae)." *Mem. ent. Soc. Canada*, no.33, 75 pp., 109 figs. 1964. Describes as new *Munroeodes australis* (Rio Vermelho, Sta. Catharina, Brazil), *M. guianae* (Pied Saut, Oyapok R., French Guiana); *SARABOTYS* (monobasic), *S. ferriterminalis* (Prov. del Sara, Bolivia); *CHILOCORSIA* (type *Phlyctaenodes punctinotalis*); *CHILOPIONEA* (monobasic), & type *C. postcuneifera* (Peru); *Chilochroma tucumana* (Siambon, Tucuman, Argentina), *C. yucatana* (Chichen Itza, Yucatan, Mexico); *PROTEPICORSIA* (type *Hapalia thyriphora*), *P. latimarginalis* (El Palmer, Prov. Chapare, Dep. Cochabamba, Bolivia), *P. bicolor* (Corupá, Sta. Catharina, Brazil), *P. maculifera* (El Palmer, Bolivia), *P. pozuzoa* (Pozuzo, Dep. Huanuco, Peru); *PSEUDEPICORSIA* (type *Pyrausta flavidensalis*), *P. septentrionis* (Callanga, Cuzco, Peru), *P. boliviensis* (Buenavista Prov. del Sara, Bolivia); *DELTOBOTYS* (type *Pyrausta brachypteralis*), *D. galba* (La Vuelta, Caura R., Venezuela); *NEOEPICORSIA* (type *Botys claudiusalis*), *N. confusa* (Corupá, Sta. Catharina, Brazil), *N. daucalis* (Fonte Boa, Amazonas, Brazil); *APONIA* (type *Pionea aponianalis*), *A. insularis* (Loma del Gato, 2,500 ft, Sierra Maestra, Cuba), *A. major* (Matagalpa, Nicaragua), *A. itzalis* (Chichen Itza, Yucatan, Mexico); *TANAOPHYSOPSIS* (type *Pyrausta xanthyalinalis*); *CHILOCHROMOPSIS* (type *Sylepta sceletogramma*) Descriptions of 13 genera & 40 spp. in all, members of Pyraustini except for the last 2 mentioned above & *Tanaophysa* (Spilomelini); includes all spp. superficially similar to *Epicorsia* (revised by Munroe, 1958) except for *mancalis* group of *Loxostege*, which is being revised by Capps. Keys to genera & spp.; figures of adults & genitalia. [P. B.]

Munroe, Eugene, & Paul R. Ehrlich, "Harmonization of concepts of higher classification of the Papilionidae." *Jour. Lepid. Soc.*, 14: 169–175, 1 fig. 1961.

Murayama, Shu-iti, "Drei neue Erebien-Rassen aus Japan" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 102–103, 2 pls. 1963. Describes as new *Erebia niphonica nyukasana* (Mt. Nyukasayama, 1,955 m, Nagano Prefecture), *E. n. tateyamana* (Mt. Tateyama, 3,015 m, Toyama Pref.), *E. n. yoshisakana* (Mt. Hakusan, 2,702 m, Ishikawa Pref.). [P. B.]

Murayama, Shu-iti, "Some new forms of *Erebia* and Theclinae from Japan" [in Japanese; English summary]. *Trans. Lepid. Soc. Japan*, 15: 16–19, 14 figs. 1964. Describes as new *E. niphonica amarisana* (Mt. Amarisan), *E. n. togakusiana* (Mt. Togakusiyama); also 4 "forms" of Theclinae. [P. B.]

Narayanan, E. S., & T. V. Venkatraman, "The identity of *Scirpophaga* species associated with sugarcane in India (Lepidoptera: Pyralidae [sic!])." *Curr. Sci.*, 20: 299–300. 1951. Concludes that only *S. nivella* occurs in India, & that it is conspecific with *S. monostigma*, *S. rhodoproctalis*, and other members of this genus previously recorded as distinct species occurring in India. [J. D.]

Nekrutenko, Yuri P., "The hidden wing-pattern of some Palaearctic species of Gonepteryx and its taxonomic value." *Jour. Res. Lepid.*, 3: 65–68, 8 figs. 1964. Figures wings of *G. rhamni*, *G. cleopatra*, & *G. mahaguru niphonica* photographed in ultraviolet light & gives key to spp. based on this pattern. [P. B.]

Newcomer, E. J., "The synonymy, variability and biology of *Lycaena nivalis*." *Jour. Res. Lepid.*, 2: 271–280, 1 pl. "1963" [1964]. Repeats original descriptions of *nivalis*, its synonym *ianthe*, & *zeroe* (a synonym of *mariposa*). Describes & figures 4 populations, including *L. n. browni*. Describes early stages (food plant *Polygonum douglasii*) & surveys distribution. [P. B.]

NOTICE TO CONTRIBUTORS TO THE *JOURNAL*

Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11" paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal*. Legends of figures and tables should be submitted on separate sheets.

Reprints may be ordered, and at least 25 gratis separates (including any other material published on these pages) will be provided, if requested at the time galley proof is received.

Address correspondence relating to the *Journal* to: Dr. J. A. POWELL, 112 Agriculture Hall, University of California, Berkeley, Calif., U. S. A.

Material not intended for permanent record, such as notices, current events, anecdotal field experiences, poems, philatelic Lepidoptera, etc. should be sent to the *News* Editor: E. J. NEWCOMER, 1509 Summitview, Yakima, Wash., U. S. A.

Address remittances and address changes to: GEORGE EHLE, 314 Atkins Ave., Lancaster, Penna., U. S. A.

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In This Issue

(Complete contents on back cover)

24 September 1965

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

Active Members—annnal dues \$6.00 (U. S. A.)
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REVIEW OF COLLECTIONS OF LEPIDOPTERA BY AIRPLANE

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It has long been established that many species of Lepidoptera are migrants and are carried by air currents far out to sea or across continents. With the continuing aid of air currents they can be carried over mountain barriers and descend in the leeward currents into the valleys below, where if conditions are favorable they can perpetuate themselves. The writer has observed butterflies drifting or flying at altitudes over 14,000 feet in the Rockies, especially the less common satyrid, *Erebia magdalena* Strecker; the pierid, *Colias meadii elis* Strecker; and a papilionid, *Parnassius* sp.

The height to which a butterfly, moth, or other insect may be carried by air currents is related to its size, weight, and buoyancy. This relationship may be expressed in terms of the aerostatic or lighter-than-air coefficient (Glick, 1939). The aerostatic coefficient varies directly with the area of the insect which is exposed perpendicular to the pull of gravitation and inversely with the weight of the insect per unit of exposed area; and therefore, the lighter the insect the greater the aerostatic coefficient, and the heavier the insect the less the aerostatic coefficient or actual buoyancy.

The vertical lift of an insect may be represented by the equation: $Ac = K\frac{R}{W}$. Ac is the aerostatic coefficient, R equals the area in metric units exposed perpendicular to gravity, W represents the weight in milligrams of the insect exposed to gravity, and K equals the constant or insect involved. Thus, any insects, particularly the more fragile butterflies and moths, occur at very high altitudes because of their relative size and weight, or buoyancy. Under the same given conditions of wind velocity and convection, a heavily built insect with small wing expanse will not

[1] In cooperation with the Texas Agricultural Experiment Station. Mention of trade names herein does not necessarily imply their endorsement by the U.S.D.A.

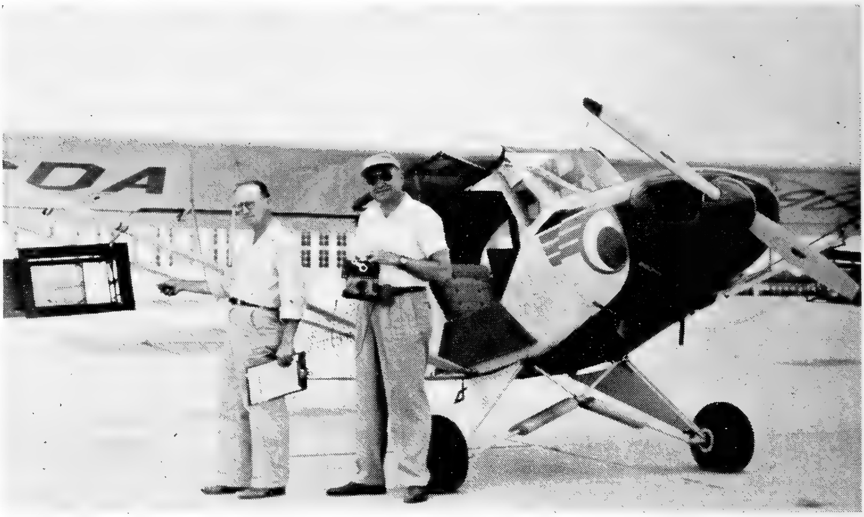

Fig. 1. Piper Cub plane equipped with insect traps placed beneath wings with control wires running from traps to cabin. A screen is partly pulled out of closed compartment for exposure as when in operation (Glick, 1955).

be carried as high as a very light insect with relatively greater wing expanse.

Most butterflies find it difficult to fly in a strong wind because their wings offer a broad surface to the air. However, certain species may even find it easier to fly directly into a strong wind, with the wings vertically closed and opened alternately so as to offer the sharpest edge to the resistance of the wind. Such a butterfly does not appear to propel itself, but to be driven forward by the action of the wind eddying against the undersurface of the wing presented to it, but how this is done is not easy to demonstrate (Tutt, 1902).

Micros are more or less at the mercy of air currents when in flight, particularly if the wind is above 6–10 miles per hour. Glick *et al.* (1956) determined that pink bollworm moths, *Pectinophora gossypiella* (Saunders), were collected in greater numbers in light traps when the wind velocity was three miles per hour or less and their flight was directly into the wind. During strong winds butterflies tend to remain close to vegetation and even the strong fliers seldom venture forth.

The writer in past years, and more recently from 1954 to 1957, made a comprehensive study of insect dissemination and distribution, with emphasis on the more important economic species (Glick, 1939, 1955, 1957, 1960, & Glick and Noble, 1961). This study, conducted with airplanes, involved some 1,552 flights. More than 1,286 hours were spent in actual

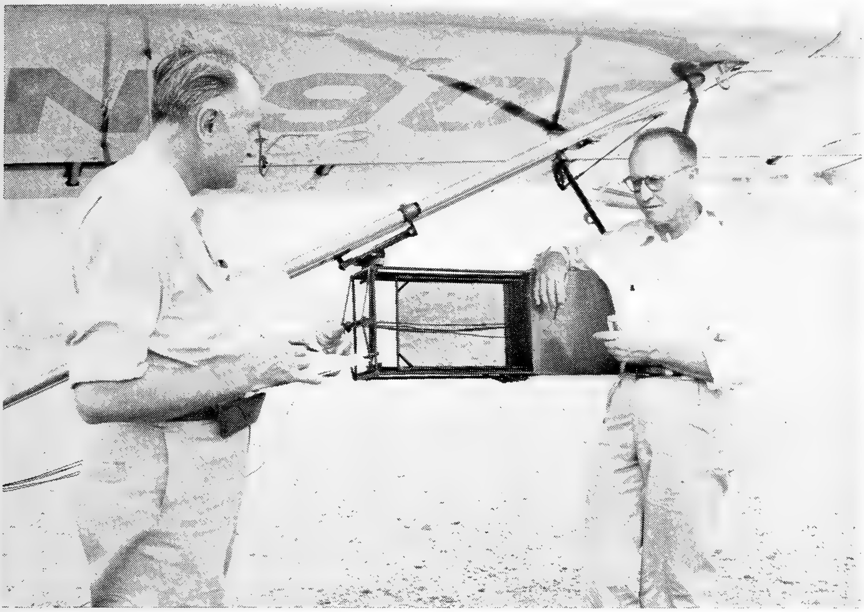

Fig. 2. Insect-collecting trap, as shown under wing of plane, with screen pulled out of closed compartment to enable removal of insects and transferring them to alcohol in vials. The pilot, Arthur Gieser (left), is recording data.

collecting with screens or nets exposed. The flights were made from altitudes near ground surface to 16,000 feet and resulted in the collection of 35,826 insects.

Procedures and Area Covered

The first airplane insect traps used in these extensive upper air insect collections were operated from 1926 to 1931 in northeast Louisiana and in Mississippi across the Mississippi River from Tallulah, Louisiana. The writer designed the original three-compartment trap, which was placed between the wings of an old JN6H Army training ship and on DeHaviland H1 Army biplanes (Glick, 1939, 1941, & 1942). These traps were also adapted for a Stinson Detroiter SM1 monoplane. In 1930 the trap was redesigned by the late G. C. McGinley to consist of two compartments. This latter type trap was used on a Piper Cub PA Super Cruiser (Figs. 1 & 2) in flights at Brownsville, Texas, in 1954, and at College Station, Texas; Shreveport, Louisiana; and Texarkana, Arkansas in 1956. In 1957 another type of trap, designed by C. N. Husman, was used in flights over northeast Louisiana, Mississippi, Illinois, and Indiana. This trap was equipped with a series of nets and operated from the plane cabin (Fig. 3).

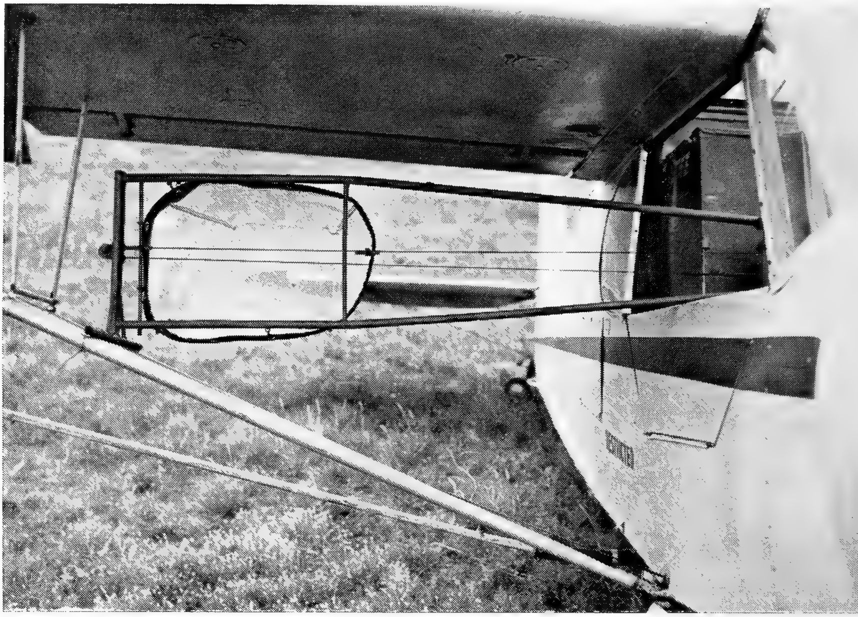

Fig. 3. Insect trap using nets in position on plane; steel tracks extend from rear of cabin to struts of plane, with net in collecting position at end of tracks (Glick, 1960).

Flights were made when weather conditions permitted both night and day collecting. The insects taken were correlated with weather and meteorological data embracing surface and upper-air recordings. The flights in northeast Louisiana from 1926 to 1931 were made throughout every month of the years involved. The other series of flights were made either in the spring, summer, or late fall.

Discussion

Lepidoptera, the only order considered in this paper, comprised probably the more important species taken, although it represented only one percent of the total insects collected in the upper air. The Lepidoptera included five families of Rhopalocera and 25 families of Heterocera, the greater portion of which were Microlepidoptera. The two families of moths in which we were most interested and for which our flights were primarily made were the Noctuidae and Gelechiidae. The family Noctuidae included several important economic species including adults of the bollworm, *Heliothis zea* (Boddie); cabbage looper, *Trichoplusia ni* (Hübner); cotton leafworm, *Alabama argillacea* (Hübner); fall armyworm, *Laphygma frugiperda* (J. E. Smith); and the armyworm, *Pseudaletia unipuncta* (Haworth). Specimens of the garden webworm,

TABLE I. LEPIDOPTERA COLLECTED BY AIRPLANE IN A SERIES OF FLIGHTS MADE IN ILLINOIS, LOUISIANA, MISSISSIPPI, AND TEXAS AT INTERVALS FROM 1926 to 1957

Family, genera, and species	State	Altitude (feet)	Number
PIERIDAE:			
Colias eurytheme Boisduval	La.	50	1
NYMPHALIDAE:			
Phyciodes tharos (Drury)	La.	50	1
Junonia coenia (Hübner)	La.	200	1
HESPERIIDAE:			
Celotes nessus	La.	20	1
Epargyreus clarus (Cramer)	La.	600	1
Hesperia leonardus Harris	La.	20	1
Lerema accius (Smith)	La.	200	1
Lerodea eufala (Edwards)	La.	200	1
AMATIDAE (Syntomidae):			
Scepsis fulvicollis (Hübner)	La.	200	1
		1,000	1
		2,000	2
"	Texas	100	1
NOCTUIDAE:			
Trichoplusia ni (Hübner)	La.	500	1
(= *Autographa brassicae* (Riley))			
"	Texas	200	1
Alabama argillacea (Hübner)	La.	200	2
		500	14
		1,000	6
		3,000	1
Bomolocha sp.	La.	500	1
Eublemma obliqualis (F.)	La.	500	1
Heliothis zea (Boddie)	La.	500	1
Laphygma frugiperda (Smith)	La.	500	4
		1,000	1
NOCTUIDAE (cont'd)			
		2,000	1
Laphygma frugiperda (Smith) (alive)	La.	500	1
Ommatochila mundula Zeller	La.	500	1
Pseudaletia unipuncta (Haworth)	Ill.	200	1
Plathypena scabra (F.)	La.	500	1
Tetanolita mynesalis (Walker)	La.	500	1
Undet. spp.	La.	500	3
		1,000	1
GEOMETRIDAE:			
Undet. spp.	La.	1,000	2
PTEROPHORIDAE:			
Oidaematophorus sp.	Texas	3,000	1
Pterophorus tenuidactylus Fitch	La.	200	1
Pterophorus sp.	La.	200	1
Undet. sp.	La.	1,000	1
PYRALIDAE:			
Pyralinae;			
Pyralis farinalis L.	La.	5,000	1
Undet. sp.	La.	600	1
Pyraustinae;			
Nomophila noctuella (Schiff.)	La.	3,000	1
Geshna primordialis Dyar	La.	500	2
		600	1
		1,000	4
Loxostege similalis (Guenée)	Texas	200	2
		500	1
	La.	500	1
		3,000	1
Microtheoris sp.	Texas	1,000	1

TABLE I (continued)

Family, genera, and species	State	Altitude (feet)	Number
PYRALIDAE (cont'd)			
Undet. spp.	La.	5,000	1
	Texas	200	2
		600	1
		1,000	1
		2,000	1
Crambinae;			
Euchromius ocelleus (Haworth)	Texas	200	1
Phycitinae;			
Elasmopalpus lignosellus (Zeller)	La.	500	3
	Texas	1,000	1
Undet. spp.	La.	500	1
	Texas	3,000	1
TORTRICIDAE:			
Olethreutinae;			
Epiblema strenuana (Walker)	La.	500	1
Celyphoides cespitana (Hübner)	La.	1,000	1
Undet. spp.	Ill.	200	1
	Texas	200	1
		2,000	2
Tortricinae;			
Undet. sp.	Texas	200	1
Phaloniidae:			
Phalonia sp.	Texas	1,000	1
COSMOPTERYGIDAE:			
Cosmopteryx spp.	Texas	200	1
	La.	1,000	1
		5,000	1
Undet. spp.	La.	500	1
	Texas	500	3
		2,000	2
Walshiidae:			
Periploca concolorella (Cham.)	Texas	200	1
Epermeniidae:			
Epermenia sp.	La.	5,000	1
GELECHIIDAE:			
Anacampsis sp.	Texas	200	1
Aristotelia sp. *roseosuffusella* (Clemens)?	La.	500	1
		1,000	1
GELECHIIDAE (cont'd)			
Aristotelia quinquepunctella Busck	La.	2,000	1
Battaristis concinusella (Chambers)	Texas	200	5
		500	1
		2,000	1
Chionodes? sp.	Texas	200	1
Dichomeris ligulella (Hübner)	La.	2,000	1
Eucordylea sp.	La.	200	1
Gelechia spp.	La.	200	1
		1,000	1
Gelechia spp. (larvae)	La.	500	1
		1,000	2
Glyphidocera sp.	Texas	200	1
Gnorimoschema spp.	Texas	100	1
		500	1
		2,000	1
Keiferia sp.	Texas	100	1
Stegasta bosqueella (Chambers)	Texas	200	1
	La.	1,000	1
Pectinophora gossypiella (Saunders)	La.	100	4
		200	6
		500	11
		1,000	5
		2,000	3
	Texas	1,000	1
BLASTOBASIDAE:			
Holcocera spp.	La.	200	2
		1,000	2
GLYPHIPTERYGIDAE:			
Glyphipteryx impigritella Clemens	La.	3,000	1
Scythrididae:			
Scythris spp.	Texas	200	1
		1,000	1
Undet. spp.	Texas	200	3
COLEOPHORIDAE:			
Coleophora spp.	Texas	200	2
		500	3

TABLE I (continued)

Family, genera, and species	State	Altitude (feet)	Number
COLEOPHORIDAE (cont'd)			
		2,000	4
		3,000	1
GRACILARIIDAE:			
Neurobatha strigifinitella (Clemens)	La.	500	1
LYONETIIDAE:			
Bedellia sommulentella Zeller	La.	2,000	1
Bucculatrix spp.	La.	200	1
		500	2
Undet. sp.	Texas	5,000	1
TISCHERIIDAE:			
Prob. *Tischeria* sp.	Ill.	1,000	1
TINEIDAE:			
Tinea spp.	La.	1,000	1
		2,000	1
NEPTICULIDAE:			
Nepticula spp.	La.	200	2

Family, genera, and species	State	Altitude (feet)	Number
Microlepidoptera undet. spp.	La.	200	4
		500	32
		1,000	12
		2,000	6
		3,000	2
		5,000	2
Lepidoptera undet. spp.	La.	20	2
		200	18
		500	28
		1,000	8
		2,000	3
		3,000	1
		5,000	2
Lepidopterous larvae	La.	200	2
Total Lepidoptera taken			319

Total flying time (hours) in Louisiana—852.9
Texas — 40.2
Illinois — 45.0

Loxostege similalis (Guenée) (Pyralidae; Pyraustinae), and the meal moth, *Pyralis farinalis* (L.) (Pyralidae), were also represented in the collections.

Several hundred flights were made to determine the height at which pink bollworm moths (*Pectinophora gossypiella* (Saunders)) could be recovered. Thirty-seven specimens were collected in Texas and Mexico at altitudes from 20 to 3,000 feet. Accordingly, since these airplane collections of pink bollworm moths have established the occurrence of the insect in the upper air, it is concluded that this destructive pest has a high power of dispersal, moving about freely in areas with suitable host material. Three larvae of the genus *Gelechia* were taken in the upper air—one at 500 feet at night, and two at 1,000 feet in the daytime. The two specimens at 1,000 feet were collected when the air was slightly rough.

It has been possible to trace the annual advance of the cotton leafworm moth from the time of its first appearance on cotton in the United States at Brownsville, Texas, to its first recorded appearance hundreds of miles

TABLE II. LEPIDOPTERA COLLECTED BY AIRPLANE IN A SERIES OF FLIGHTS MADE AT TLAHUALILO, DURANGO, MEXICO, SEPTEMBER, 1928[1]

Family, genera, and species	Altitude (feet)	Number
SATYRIDAE:		
Undet. sp.	20	1
LYCAENIDAE:		
Hemiargus isola (Reakirt) (*H. isola isola* (Reakirt))	1,000	1
PTEROPHORIDAE:		
Undet. sp.	20	1
TORTRICIDAE.		
Oleuthreutidae;		
Epiblema sosana (Kearfott)	100	1
GELECHIIDAE:		
Gnorimoschema sp.	2,000	1
Pectinophora gossypiella (Saunders)	20	4
	100	1
	1,000	1
	3,000	1
HELIODINIDAE:		
Undet. spp.	500	1
	1,000	1
SCYTHRIDIDAE:		
Scythris sp.	100	1
GRACILLARIIDAE:		
Undet. sp.	2,000	1
Lepidoptera undet. sp.	20	1
Macrolepidoptera undet. sp.	20	1
Total Lepidoptera collected		18
Total flying time (hours)—35.3		

[1] Tlahualilo is situated in the Laguna District of Durango and Coahuila, some 43 miles north of Torreon.

northward. Comparisons of the records for seven years showed that it took 40 to 58 days, or an average of 56 days, for the moth to appear on cotton in northern Louisiana after its initial appearance in southern Texas near Brownsville. From the first record of the moth in fields near Brownsville to the first report of the moth from Wisconsin there was an average of 107 days, with 121 days for Minnesota and 113 days for Michigan. The airplane collections furnished additional information on the flight and migration activity of this moth. There were 23 specimens taken at altitudes from 500 to 3,000 feet. In 1929 the first moth found at Tallulah was taken in the airplane trap on August 5 at the altitude of 3,000 feet. This moth probably was a migrant, since neither eggs nor larvae had been reported in Louisiana previously (Glick, 1939).

The five families of butterflies represented in the airplane collections were Lycaenidae, Nymphalidae, Pieridae, Satyridae, and Hesperiidae.

The known species represented included the pierid, *Colias urytheme* Boisduval, and the nymphalids, *Phyciodes tharos* (Drury), and *Junonia coenia* (Hübner). The specimens were taken from near ground surface to altitudes up to 500 feet in northeast Louisiana. Five determined species of Hesperiidae, taken in the airplane collections up to 600 feet, included *Epargyreaus clarus* (Cramer), *Celotes nessus* (W. H. Edwards), *Hesperia leonardus* Harris, *Lerema accius* (J. E. Smith), and *Lerodea eufala* (W. H. Edwards). A small lycaenid, *Hemiargus isola* (Reakirt), was taken in Mexico near Torreon at 1,000 feet. An interesting incident occurred during a flight in northern Texas when numbers of monarch butterflies (*Danaus plexippus* (L.)) were encountered at 2,000 feet, but were able to evade the plane and continue on their course.

The list of species, genera, and families represented in the airplane collections of insects is shown in Table 1.[2]

Summary

Collections of Lepidoptera and other orders of insects were taken in the upper air with the use of airplanes equipped with specially designed insect-collecting traps. Over 1,500 flights were made over Texas, Louisiana, Arkansas, Mississippi, Illinois, Indiana, and in Mexico to study the flight and seasonal activity of certain species of economic insect pests. Other insects encountered were also recorded. Lepidoptera composed only one percent of the total insects collected, but 25 families of Heterocera and five families of Rhopalocera were represented in the overall collections.

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[2] Information in Table 1 compiled from several publications by the author, but taxonomic names appear as presently used.

BOOK REVIEW

BUTTERFLIES OF THE SAN FRANCISCO BAY REGION. California Natural History Guide No. 12. By J. W. Tilden. University of California Press, Berkeley and Los Angeles, California. Paperback, 88 pp., 38 text figs., 8 color plates + color illustration on cover. Price $1.75.

"Have you ever encountered a West Coast Lady, a Flying Pansy, or an Ox-eyed Satyr?"—so goes the opening statement in the advance publicity flier for this 4¼-by 7¼-inch field guide.

This guide, being directed for the amateur as well as the naturalist, contains an initial introduction and sections on What are butterflies?; How to study butterflies; and, Identifying butterflies. This part comprises some 25 pages and, like many "field guides" published during the past century, starts at the "basic beginning" and can appeal to heterogeneous disciplines from grammar school, boy scouts, hobbyists, etc. to the moderately advanced entomologist, naturalist, and forest ranger. The many-times published "typical" venation of the monarch butterfly is illustrated, along with different types of scales in various families, antennae, parts of the leg, etc. Eggs, caterpillars, and pupae are also figured—all examples being of species that occur in the Bay Area.

Various techniques from the year one to advanced present-day methods are given. This includes constructing a net, making cyanide jars, collecting, pinning, relaxing specimens, spreading, storing specimens in envelopes, and rearing methods (e.g., caging females to rear from eggs, collection, and preservation of larvae, pupae, etc.).

The main value of this book to the hobbyist and resident Bay Area collector, however, is the remaining section on "Bay Region Butterflies: Species Accounts." Recorded from this region are 122 different species representing eight of the 10 families of the Nearctic butterflies.

The work is illustrated by Gene M. Christman. Black-and-white figures are sprinkled liberally throughout the text, and bound into the center are eight colored plates bearing from four to 29 right-half drawings, at or close to natural size. They show the upper surfaces of about 75 species and subspecies, and in many instances also show both sexes and/or undersurfaces, particularly where they are diagnostic. As with many drawings (as opposed to photographic reproduction) there are some inaccuracies, especially in overall wing shape and proportions. In some, the color did not come through true (e.g., both satyrs, leanira checkerspot, both metalmarks, acmon, and sonora blues). However, all species are recognizable and, through no fault of the author or illustrator, it is about the best to be expected short of the more expensive process of plates from actual color photographs.

With the intent of making it appealing to the amateur, common names are given for the species. Since common names are not in common use for many of them, especially at the subspecies level, some were unknown to this reviewer (e.g., ox-eyed satyr, American painted lady, black and gold sulfur, gold-hunter's hairstreak, sad duskywing and dog-star skipper). However, for the scientist, the Latin names are given for each entity, and these are repeated (with authors' names) at the end of the book in a "Checklist of Bay Region Butterflies" which also doubles as the index.

The individual species accounts not only deal with those more commonly encountered, but with many that are only known from a single or very few records. For example, some that are thought of as "Sierran species" or of northerly distribution are listed in the ill-defined Bay Region: *Polygonia silvius, Neophasia menapia, Papilio indra*, and *Amblyscirtes vialis*. Others of southerly origin are listed as occurring sparingly within the area: *Phoebis sennae marcellina, Leptotes marina*, and *Philotes battoides bernardino*. However, these facts are so stated under each entity, along with the others being "common," "in vacant lots," "along roadsides," etc.

This guide appears to accomplish the purpose for which it was intended. It should prevent the beginning amateur from losing interest, and stimulate the "resident experienced collector" to go out after the rarities close to home.—ROBERT L. LANGSTON, *University of California, Berkeley.*

EUPTYCHIA AREOLATA: DISTRIBUTION AND VARIATION, WITH SPECIAL REFERENCE TO MISSISSIPPI (SATYRIDAE)

Bryant Mather
Jackson, Mississippi

Euptychia areolata (J. E. Smith) apparently was first collected in Mississippi at Biloxi, Harrison County, on April 10, 1921 by the late Dr. F. M. Jones (*in litt.*, 1953). The first records were published by Brown (1949, 1950a), who referred to its occurrence at Gulfport, Harrison County, based on reports by Harold I. O'Byrne (Sept. 1–4) and F. M. Jones (Apr. 28–May 18). Brown's map (1950a) indicated occurrence only in the extreme southeastern portion of the state. Mather and Mather (1958) knew of 18 specimens and regarded theirs from Burnsville, Tishomingo County, within 12 miles of the Tennessee line, a significant extension of the known range. Sixty-five specimens are now known. The 12 localities in Mississippi from which *E. areolata* is known to have been taken are shown in Fig. 1; they are situated in eight of the 82 Mississippi counties. The 65 Mississippi specimens, classified by locality, date, and sex (were known), are indicated in Table 1. Forty-eight of these specimens were examined at the U. S. National Museum through the courtesy of Mr. William D. Field on January 5, 1959 and checked particularly as to their assignment to sex; three had previously been determined by Mr. C. F. dos Passos.

Specimens are at hand representing 56 of the 65 recorded; these include 29 ♂♂ and 27 ♀♀. The other nine specimens known are: the one collected by F. M. Jones which is presumably at the USNM; four collected by H. I. O'Byrne, which were examined in the collection at the University of Missouri in 1953 by K. Mather; three collected by Mather and Mather, two of which are in the collection of C. F. dos Passos and one of which is in the collection at Mississippi State University; and one, or more, collected in May, 1961 by W. J. Reinthal (1962) and presumably in his collection.

Variation in Mississippi

The 56 available specimens have been examined particularly with regard to the development and shape of spots on the undersurfaces of the wings. The variation in development of spots on the underside of the forewings, based on the examination of the undersurface of the left forewing, ranged from no spots to four. Ten conditions were distinguished and the specimens examined were distributed among them as follows:

	♂♂	♀♀	Total
Spots absent	4	5	9
Trace of one spot	5	3	8
One spot	7	4	11
Traces of two spots	3	6	9
One spot and trace of second	4	1	5
Two spots	4	3	7
Traces of three spots	0	1	1
Three spots	0	4	4
Traces of four spots	1	0	1
Four spots (specimen #14) (see Plate I)	1	0	1
	29	27	56

The development of spots on the undersurface of the left hindwing was studied both with regard to number present and degree of elongation. Figure 2 is a diagram showing the designations used in this study and the dimensions that were measured at length (L) and width (W). The number of spots found ranged from four to six. One specimen (a ♀,

TABLE 1. MISSISSIPPI RECORDS OF *Euptychia areolata*

Locality and County	Month							Total	Collector
	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.		
Burnsville, Tishomingo	–	–	–	–	1 ♀	–	–	1	B & K Mather
Barnett, Clarke	–	–	–	–	–	2 ♂♂	–	2	M & E Roshore
Waynseboro, Wayne	–	–	–	–	–	1 ♂	–	1	B & K Mather
Goss, Marion	–	–	1 ♀	–	–	–	–	1	B & K Mather
Rawl's Springs, Forrest	–	–	–	–	–	1 ♀	–	1	M & E Roshore
Hattiesburg, Forrest	–	1 ♀	–	–	–	–	–	1	B. J. Miller[1]
Shelby State Park, Forrest	–	–	–	–	5 ♂♂, 3 ♀♀	16 ♂♂, 15 ♀♀	–	39	M & E Roshore (38), B & K Mather (1)
Whites Crossing, Stone	–	1o	–	–	–	–	–	1	W. J. Reinthal
Biloxi, Harrison	1o	–	–	–	–	–	–	1	F. M. Jones
Gulfport, Harrison	–	–	–	–	–	4 ♂♂, 1 ♀	–	5	B & K Mather (1), H. I. O'Byrne (4)
Ocean Springs, Jackson	–	–	2 ♂♂, 2 ♀♀, 3 o o	–	2 ♂♂, 1 ♀	–	1 ♀	11	B & K Mather (9), M & E Roshore (2)
Fontainbleau, Jackson	–	–	–	1 ♂	–	–	–	1	B & K Mather
	1	2	8	1	12	40	1	65	

[1] *Ex* coll. B. D. Valentine.

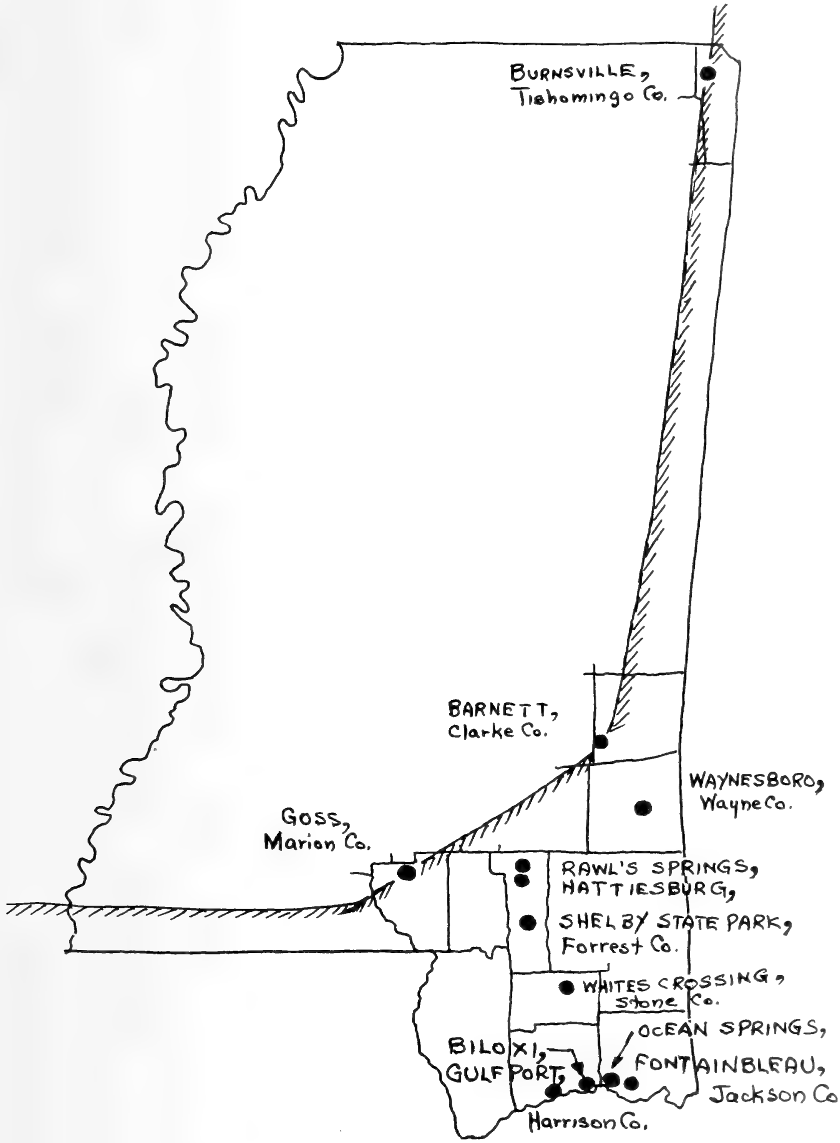
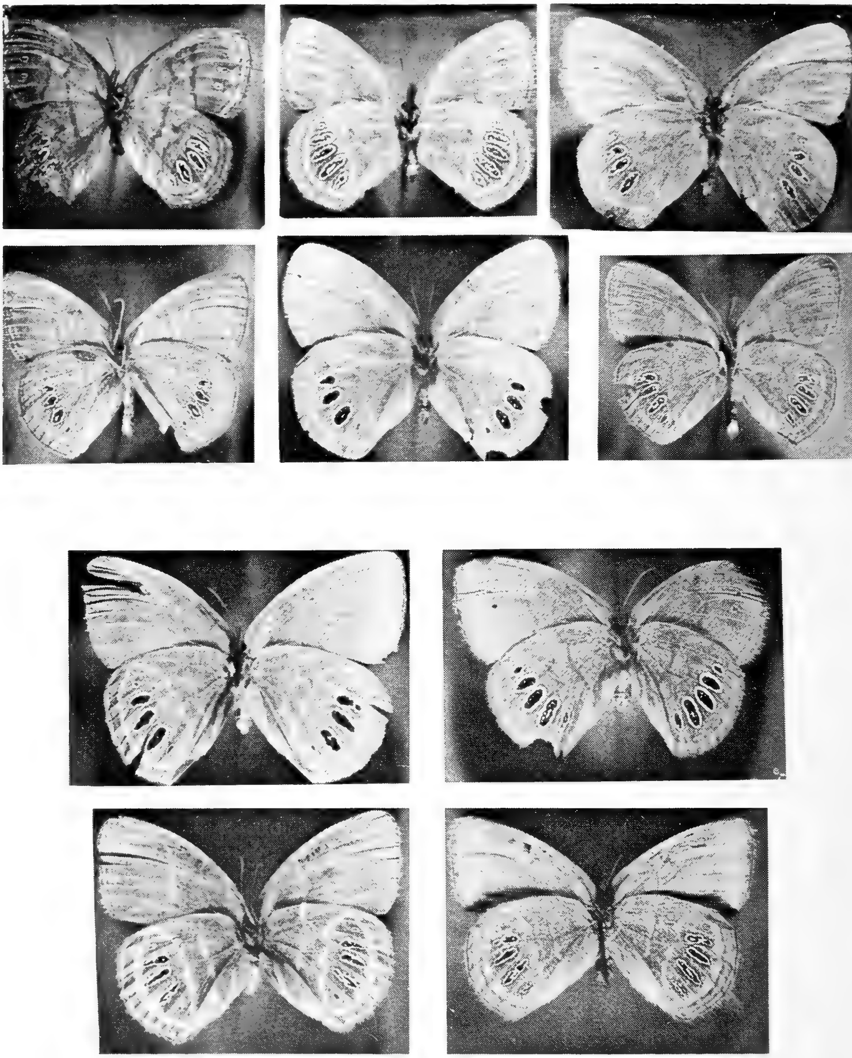


Fig. 1. Known distribution of *Euptychia areolata areolata* (Smith) in Mississippi.

#38) (see Plate I) had only a trace of spot #1. One other specimen (a ♀, #42) (Plate I) had all six spots quite well developed. A third specimen, also a ♀, #36 had a trace of spot #6. The other 54 specimens had no trace of spot #6; but all except #38 had spots #1, 2, 3, and 4 well



EXPLANATION OF PLATE I

Undersides of eight Mississippi and two Florida specimens of *Euptychia a. areolata*; average length/width ratios of spots 1–4 as follows: (For complete data of Mississippi specimens see Table 2.) *Top row*: left, ♂ #14, Shelby St. Park, L/W = 2.5; middle, ♀ #42, Shelby St. Park, L/W = 2.7; right, ♀ #38, Shelby St. Park, L/W = 2.2. *Second row*: left, ♂ #49, Fountainbleau, L/W = 1.7; middle, ♀ #44, Shelby St. Park, L/W = 1.7; right, ♂ #11, Shelby St. Park, L/W = 3.0. *Third row*: left, ♀ #25, Goss, L/W = 2.4; right, ♀ #24, Burnsville, L/W = 2.2. *Bottom row*: left, ♀ #57, Orange Park, Fla., May 25, 1959, L/W = 3.1; right, ♀ #63, Jacksonville, Fla., May 30, 1959, L/W = 3.7.

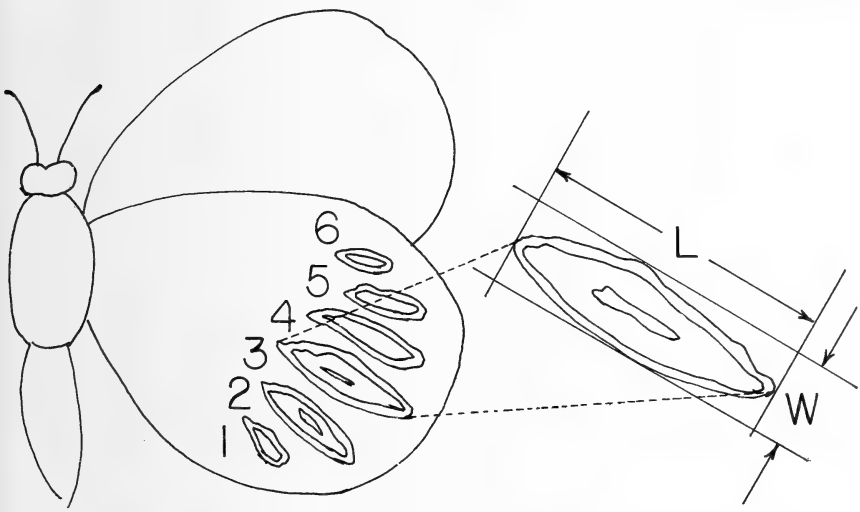


Fig. 2. Diagram showing the numbers assigned to the spots on the underside of the hindwing of *Euptychia areolata* and the dimensions measured as length (L) and width (W).

developed. The greatest variation in the series was with respect to spot #5; data on which are given below.

	♂♂	♀♀	Total
Spot absent	7	6	13
Absent on right, trace on left	2	1	3
Absent on left, measured on right	1	0	1
Trace on both wings	3	1	4
Present and measured on both wings	16	19	35
	—	—	—
	29	27	56

The length (L) and width (W) of each spot on the left hindwing venter (in two cases, the right hindwing was used because of damage to the left wing) were measured at a magnification of 10× using an eyepiece micrometer having graduations such that at this magnification one division was equal to 0.1 mm. Using these measurements, the L/W ratio was computed for each spot. From the L/W ratios for spots #1, 2, 3, 4, an average L/W ratio was computed for each specimen. These data are given in Table 2. Figures 3 and 4 plot length and width of each measured hindwing spot identified as to spot number and sex of the specimen. The maximum, minimum, and average value of L/W for each spot and for the extreme specimens for average L/W were as follows:

TABLE 2

DIMENSIONAL DATA ON SPOTS ON HINDWING BELOW FOR MISSISSIPPI AREOLATA *

Length (L) and Width (W) given in 0.1-mm. units

SPECIMEN NUMBER AND LOCALITY	DATE	#1 L W L/W	#2 L W L/W	#3 L W L/W	#4 L W L/W	#5 L W L/W	#6 L W L/W	Av. 1–4 L/W	Spots on forewing
				♂♂					
49 FONTAINBLEAU	31 JUL 60	11 7 1.6	22 12 1.8	21 11 1.9	15 9 1.7	Trace	Absent	·1.7	Absent
21 SHELBY ST. PK.	6 SEP 58	20 10 2.0	29 15 1.9	26 14 1.8	27 13 2.1	10 6 1.7	Absent	1.9	One + Trace
13 "	"	15 7 2.1	27 15 1.8	25 14 1.8	27 11 2.5	Tr. - Abs.	Absent	2.0	Two
9 "	"	13 8 1.6	28 11 2.5	25 11 2.3	18 9 2.0	5 4 1.2	Absent	2.1	Two
10 "	"	18 6 3.0	27 14 1.9	22 13 1.7	21 12 1.7	9 4 2.2	Absent	2.1	One
52 "	13 AUG 60	20 10 2.0	32 15 2.1	26 12 2.2	26 12 2.2	8 7 1.1	Absent	2.1	Four
55 "	"	20 8 2.5	28 14 2.0	24 12 2.0	26 14 1.8	Absent	Absent	2.1	One + Trace
1 WAYNESBORO	20 SEP 53	16 8 2.0	27 14 1.9	29 10 2.9	21 10 2.1	Absent	Absent	2.2	Trace
4 OCEAN SPRINGS	2 AUG 58	16 6 2.7	22 12 1.8	19 10 1.9	21 8 2.6	Absent	Absent	2.2	Trace
16 SHELBY ST. PK.	6 SEP 58	8 4 2.0	29 13 2.2	26 13 2.0	25 10 2.5	Absent	Absent	2.2	Two
18 "	"	19 8 2.0	31 13 2.4	25 12 2.1	29 13 2.2	Trace	Absent	2.2	One
19 "	"	14 5 2.8	23 11 2.1	25 11 2.3	15 9 1.7	Absent	Absent	2.2	Absent
20 "	"	10 6 1.7	26 10 2.6	21 10 2.1	22 9 2.4	9 5 1.8	Absent	2.2	Trace-Two
51 "	13 AUG 60	21 8 2.6	32 14 2.3	25 12 2.1	20 11 1.8	10 6 1.6	Absent	2.2	Trace-Two
53 "	"	9 5 1.8	28 15 1.9	26 11 2.4	26 10 2.6	11 4 2.7	Absent	2.2	Trace-One
6 BARNETT	7 SEP 58	20 9 2.2	30 15 2.0	28 12 2.3	31 11 2.8	11 6 1.8	Absent	2.3	One
7 SHELBY ST. PK.	6 SEP 58	10 6 1.6	24 11 2.2	24 10 2.4	20 7 2.9	Absent	Absent	2.3	Trace
22 "	"	18 7 2.6	31 13 2.4	30 12 2.5	28 12 2.3	18 7 2.6	Absent	2.4	One
3 OCEAN SPRINGS	13 JUN 52	12 5 2.4	26 11 2.4	24 10 2.4	26 9 2.9	4 4 1.0	Absent	2.5	Absent
12 SHELBY ST. PK.	6 SEP 58	15 7 2.1	33 11 3.0	26 11 2.4	27 10 2.7	4 4 1.0	Absent	2.5	One

TABLE 2 continued

14 SHELBY ST. PK.	6 SEP 58	18 8 2.2	29 13 2.2	28 11 2.5	31 10 3.1	10 5 2.0	Absent	2.5	Four
15 "	"	18 7 2.6	31 12 2.6	22 10 2.2	26 10 2.6	7 6 1.2	Absent	2.5	One
23 BARNETT	7 SEP 58	25 7 3.6	28 14 2.0	27 12 2.1	29 10 2.9	Tr.- Abs.	Absent	2.6	Absent
54 SHELBY ST. PK.	13 AUG 60	19 9 2.1	29 12 2.4	26 10 2.6	28 8 3.5	9 6 1.5	Absent	2.6	Two
2 OCEAN SPRINGS	13 JUN 52	15 4 3.7	26 10 2.6	23 10 2.3	21 10 2.1	Absent	Absent	2.7	Trace
5 "	2 AUG 58	14 5 2.8	27 11 2.5	25 10 2.5	26 8 3.2	5 4 1.2	Absent	2.7	One
8 SHELBY ST. PK.	6 SEP 58	15 6 2.5	27 11 2.5	21 10 2.1	25 7 3.6	4 4 1.0	Absent	2.7	One
17 "	"	22 6 3.7	35 12 2.9	26 12 2.2	26 12 2.2	Trace	Absent	2.7	Trace-Two
11 "	"	17 6 2.8	31 10 3.1	26 8 3.2	27 9 3.0	4 3 1.3	Absent	3.0	One + Trace
			♀♀						
44 SHELBY ST. PK.	6 SEP 58	12 9 1.3	31 17 1.8	29 16 1.8	24 13 1.8	Absent	Absent	1.7	Absent
35 "	"	23 13 1.8	36 19 1.9	32 18 1.8	35 13 2.7	17 9 1.9	Absent	2.0	Three
37 "	"	18 9 2.0	31 16 1.9	28 13 2.1	28 13 2.1	13 5 2.6	Absent	2.0	Absent
50 "	13 AUG 60	15 9 1.7	39 19 2.0	35 16 2.2	33 15 2.2	14 5 2.8	Absent	2.0	Trace-Two
48 "	6 SEP 58	15 9 1.7	32 16 2.0	30 13 2.3	28 14 2.0	18 6 3.0	Absent	2.0	Absent
27 OCEAN SPRINGS	13 JUN 52	7 5 1.4	29 12 2.4	24 10 2.4	24 10 2.4	Absent	Absent	2.1	One
32 RAWL'S SPRINGS	6 SEP 58	12 8 1.5	38 16 2.4	31 15 2.1	27 11 2.5	Absent	Absent	2.1	One
39 SHELBY ST. PK.	"	19 9 2.1	31 14 2.2	27 12 2.1	27 12 2.1	7 5 1.4	Absent	2.1	Two
47 "	"	18 9 2.0	32 16 2.0	29 15 1.9	30 13 2.3	16 8 2.0	Absent	2.1	Three
24 BURNSVILLE	28 AUG 55	24 11 2.2	40 16 2.5	38 17 2.2	33 16 2.1	16 10 1.6	Absent	2.2	Trace-Two
26 HATTIESBURG	28 MAY 55	15 7 2.1	34 14 2.4	30 18 1.7	31 12 2.6	16 6 2.7	Absent	2.2	One
36 SHELBY ST. PK.	6 SEP 58	18 7 2.6	29 15 1.9	29 14 2.1	29 12 2.4	13 8 1.6	Trace	2.2	Three
38 "	"	Trace	29 12 2.4	30 12 2.5	19 11 1.7	12 7 1.7	Absent	2.2	Absent
45 "	"	17 8 2.1	32 14 2.3	25 12 2.1	23 11 2.1	Absent	Absent	2.2	Absent
33 "	3 AUG 58	17 9 1.9	33 13 2.5	31 15 2.1	29 11 2.6	13 6 2.2	Absent	2.3	Three
34 "	6 SEP 58	20 9 2.2	34 16 2.1	31 13 2.4	30 12 2.5	14 7 2.0	Absent	2.3	One
25 GOSS	15 JUN 52	17 7 2.4	38 15 2.5	42 17 2.5	37 16 2.3	12 5 2.4	Absent	2.4	Trace
31 GULFPORT	23 SEP 51	15 6 2.7	30 13 2.3	22 9 2.4	22 11 2.0	9 5 1.8	Absent	2.4	Trace-Two

TABLE 2 concluded

40 SHELBY ST. PK.	6 SEP 58	14 6 2.3	33 13 2.5	27 13 2.1	27 10 2.7	Tr. – Abs.	Absent	2.4	Trace - Two
56 "	13 AUG 60	22 9 2.4	35 16 2.2	35 15 2.3	36 13 2.7	22 10 2.2	Absent	2.4	Trace
28 OCEAN SPRINGS	13 JUN 52	13 6 2.2	32 11 2.9	24 10 2.4	26 11 2.4	Absent	Absent	2.5	Trace - Two
43 SHELBY ST. PK.	6 SEP 58	16 6 2.7	31 15 2.1	32 13 2.5	32 10 3.2	14 6 2.3	Absent	2.6	Trace - Three
46 "	"	25 8 3.1	38 16 2.4	34 15 2.3	33 13 2.5	13 6 2.2	Absent	2.6	Two
29 OCEAN SPRINGS	3 OCT 53	12 5 2.4	32 11 2.9	30 10 3.0	23 9 2.5	8 5 1.6	Absent	2.7	Trace - Two
30 "	2 AUG 58	15 6 2.7	37 12 3.1	27 10 2.7	25 10 2.5	Absent	Absent	2.7	Trace
41 SHELBY ST. PK.	6 SEP 58	21 6 3.5	36 12 3.0	27 12 2.1	26 12 2.2	Trace	Absent	2.7	Two
42 "	"	20 9 2.2	39 13 3.0	31 12 2.6	29 9 3.2	14 6 2.3	6 4 1.5	2.7	One + Trace

* Tabulated in order of increasing average l/w for spots 1-4 in each group : ♂♂ and ♀♀.

		#1	#2	#3	#4	L/W Avg: 1–4
29 ♂♂	max	3.7	3.1	3.2	3.6	3.0 (#11)[1]
	min	1.6	1.8	1.7	1.7	1.7 (#49)[1]
	average	2.4	2.3	2.2	2.5	(2.3)
27 ♀♀	max	3.5	3.1	3.0	3.2	2.7 (#30, #42)[1]
	min	1.3	1.8	1.7	1.7	1.7 (#44)[1]
	average	2.2	2.4	2.2	2.4	(2.3)

[1] See Plate I.

Figure 5 indicates the frequency distribution of average L/W for spots 1–4 for the 56 Mississippi specimens and the approximately normal shape of the distribution curve suggested by this histogram. Measurements of length and width of spot #2 are plotted in Figure 6 together with lines representing L/W = 1.8 and 3.1, the minimum and maximum values for elongation found for this spot.

Geographical Distribution

Brown (1950a) indicated that *E. areolata* is distributed throughout Florida, Georgia, South Carolina, and North Carolina, and in southeastern Virginia, southern New Jersey, eastern Tennessee, southern Alabama, southeastern Mississippi, and southeastern Louisiana. Harris (1931) reported that it was found in the coastal region of Georgia; the same writer (1950) reported it throughout the state. Knudsen (1954) did not find it on the Oglethorpe University campus but regarded it as a species that might be tentatively added to his list based on its having been reported as distributed throughout the state of Georgia, but very local in occurrence. A. H. Clark (*in litt.* to Brown, 1950) mentioned the occurrence of *areolata* in West Virginia. Haydon (1934) listed the species as probable for Maryland, but based on recent reports, Simmons (1956, 1963), Simmons and Andersen (1961), it does not seem to have been recorded from that state. Davis (1924) mentioned a specimen from Harris County, Texas, and Texas specimens are figured by Clark (1932), Clark and Clark (1951), and Ehrlich and Ehrlich (1961). It was, however, not included in the tentative list of Texas butterflies compiled by Kendall (1963b) nor was it mentioned by Gooch and Strecker (1924). Forbes (1960) gave the range as "southern states north to New Jersey," Ehrlich and Ehrlich (1961) gave it as "southeastern United States north to Ocean County, New Jersey." Lambremont (1954) recorded it for the first time from Louisiana, based on 31 specimens (15 ♂♂, 16 ♀♀) from nine localities in Livingston, St. Tammany, Tangipahoa, and Washington parishes, all in the "longleaf pine flats north of Lake Ponchartrain." He observed: "Supposedly the species ranges as far west as Texas, but the

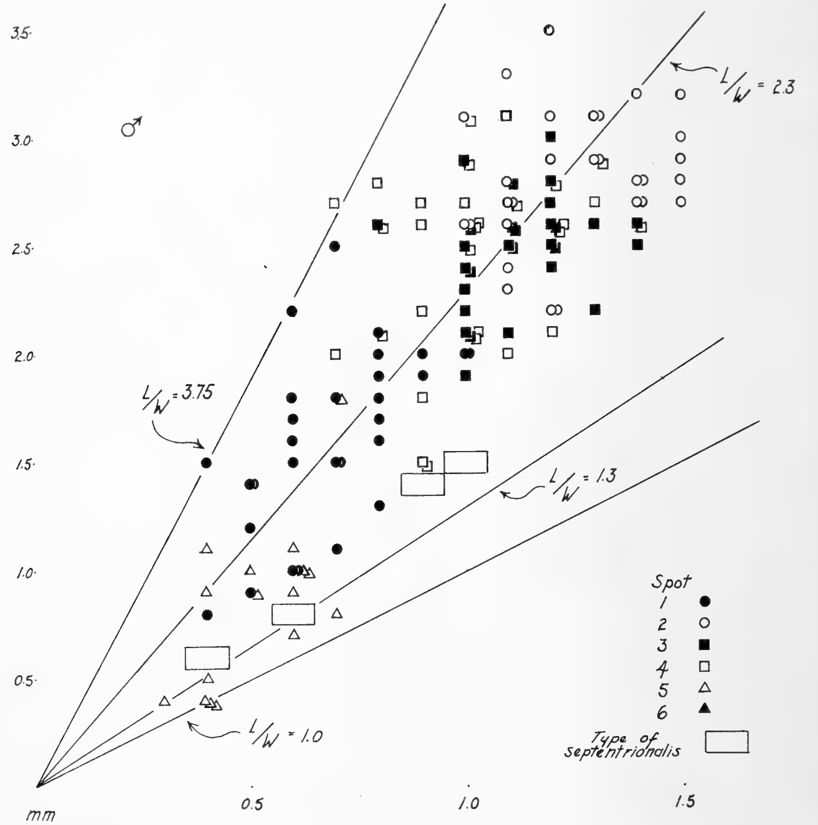


Fig. 3. Plot of length (vertical axis) and width (horizontal axis) of spots on 29 male specimens of *Euptychia a. areolata* from Mississippi, showing the relative positions of the measurements of spots on the figure of the type specimen of *E. areolata septentrionalis* (Davis).

results of this survey indicate it must be rare west of the Mississippi River, although it localizes and can be overlooked." Kendall (1963a) reported taking one male on June 30, 1957 at Leesville, Vernon Parish, which is less than 20 miles east of the Texas border and about 10 miles north of Latitude 31, the boundary between Louisiana and Mississippi east of the Mississippi River. If the closely related *E. mitchellii* (French), described from Cass County, Michigan, were to be considered a northern race of *E. areolata*, the distribution would form a pattern rather similar to that known for *Euphyes dukesi* (Lindsey) as was shown by Mather (1964). The known distribution of *E. areolata* (and of *E. mitchellii*) is shown by the stippled areas in Fig. 7.

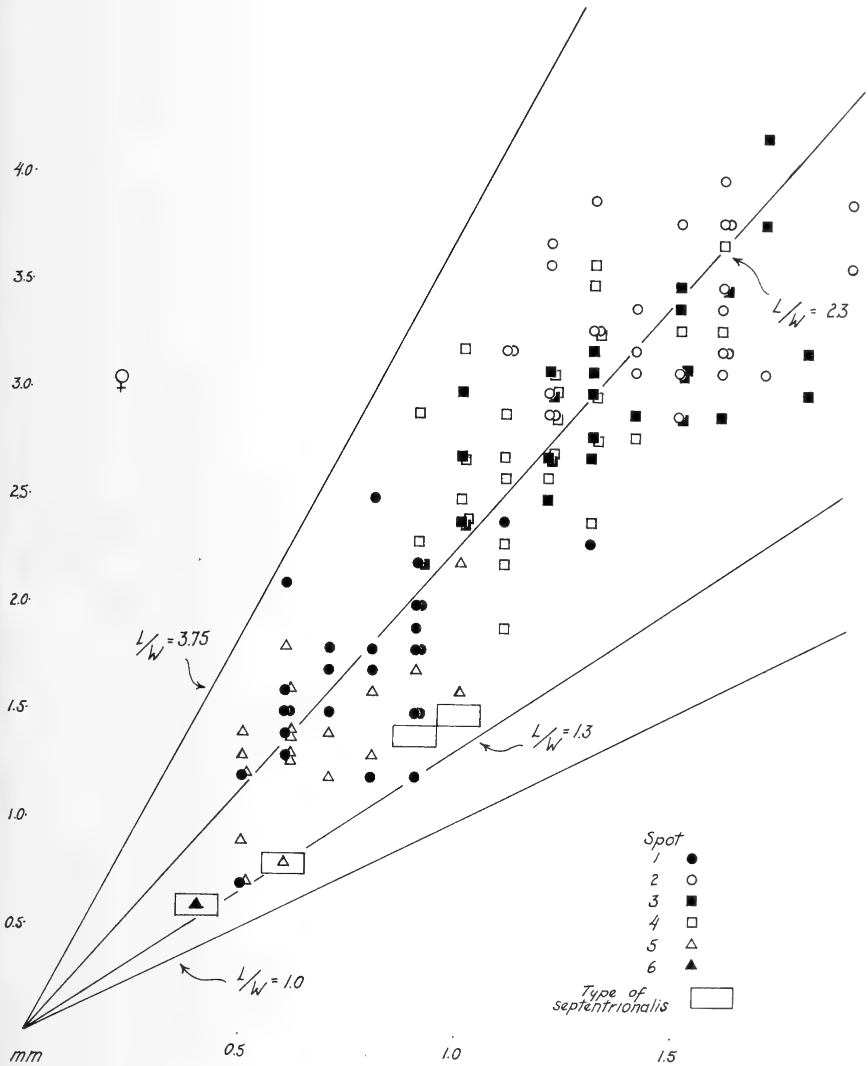


Fig. 4. Plot of length (vertical axis) and width (horizontal axis) of spots on 27 female specimens of *Euptychia a. areolata* from Mississippi, showing the relative positions of measurements of spots on the figure of the type specimen of *E. areolata septentrionalis* (Davis).

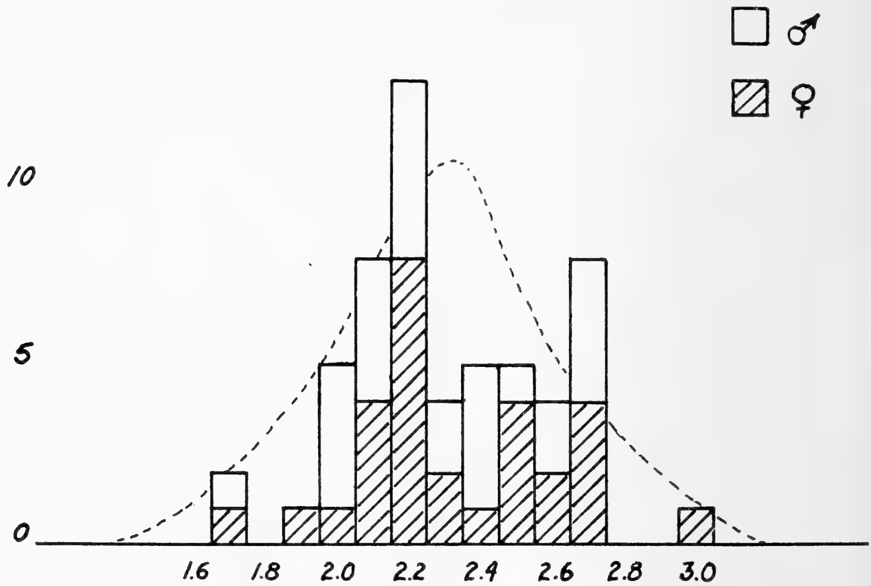


Fig. 5. Average of length/width ratios of spots 1–4 on 56 Mississippi specimens of *Euptychia a. areolata* and the apparently normal distribution curve suggested by these data.

Seasonal Distribution

The Mississippi records are all from localities that have been visited by collectors only relatively infrequently; thus while it is regarded as probable that the occurrence of *E. areolata* in Mississippi is generally limited to the period April through October, it is not believed that the relative abundance within this period can be judged from the number of specimens recorded per month. These figures probably tell more about the mobility of the collectors than about the abundance of the butterflies. Lambremont (1954) took his 31 Louisiana specimens in May, June, and September. Clark and Clark (1951) report two broods in Virginia, April–May and August–September. Harris (1950) reported it in Georgia "April–October." Grossbeck (1917) gave dates of occurrence in Florida in March through June and September and October. The available data are given below.

	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Ref
Mississippi		×	×	×	×	×	×	×	This report
Louisiana			×	×			×		Lambremont (1954), Kendall (1963)
Florida	×	×	×	×			×	×	Grossbeck (1917)

	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Ref
Georgia	×	×	×	×	×	×	×		Harris (1950)
Tennessee					×				Martin and Truxal (1955)
Virginia	×	×			×	×			Clark and Clark (1951)
New Jersey				×					Davis (1924)
North Carolina			×						Davis (1924)
Michigan[1]			×	×					Martin and Truxal (1955)
Indiana[1]				×					Martin and Truxal (1955)

[1] *E. mitchellii.*

Seasonal Variation

The sample available for study included only seven specimens taken on dates in May, June, and July, but 49 taken on dates in August, September, and October. The single available specimens representing May and October are both females (#26 and #29, see Table 2). The data on these specimens do not indicate significant differences; nor are such differences clearly shown by other comparisons within the series. Badger (1958) figured specimens of *E. mitchellii* showing maximum and minimum development of spots on the wings beneath, that were taken within a single four-day period.

Sexual Variation

The ground color of the upper surfaces of the wings is darker in males and lighter in females. Previous writers do not present a consistent discussion of what these colors are. French (1889), describing *E. mitchellii*, referred to the color of the upper surfaces of the male as "gray wood-brown, rather dark" and stated that the female "differs from the male in being paler both above and below." He did not indicate that *mitchellii* differed from *areolata* in this respect. Clark and Clark (1951) refer to *E. a. areolata* as "dark mouse gray" and to *E. a. septentrionalis* (Davis) as "dark warm brown" and did not indicate that the different sexes of either race varied in color. Forbes (1960) said "plain fuscous above" for *areolata.* From an examination of specimens at hand, it is concluded that Mississippi populations meet the description given by French (1889) for *E. mitchellii*; that the males meet the description given by Clark & Clark (1951) for *E. a. areolata*; and the females meet the description given by them for *E. a. septentrionalis.* There appears to be no significant variation between the sexes with regard to elongation of the spots on the hindwings below. It is not regarded as significant that both specimens showing four spots on the underside of the forewing were males and all five of those that showed three were females. The ratio in which the sexes are represented among the material collected is remarkable close to 1 : 1 in those cases where all specimens were taken that were available.

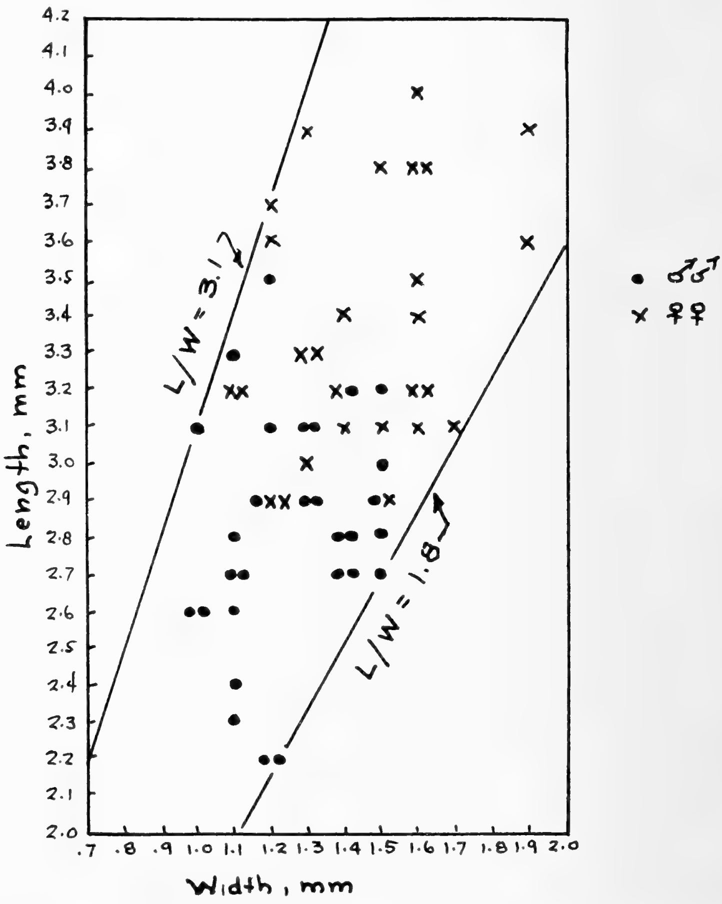


Fig. 6. Length and width for spot #2 on 56 Mississippi specimens of *Euptychia a. areolata,* indicating a L/W range from 1.8 to 3.1.

GEOGRAPHICAL VARIATION

E. areolata was described by J. E. Smith from Georgia. Davis (1924) noted that in the figure accompanying the original description, in which the underside is shown, there are four round blackish spots encircled by yellow on each forewing and six elongate spots encircled by yellowish on each hindwing. He also noted that Boisduval and Le Conte figured a specimen with elongate spots on the hindwing venter, that Scudder figured one from Georgia with five elongate spots on the hindwing underside, and that Edwards figured three specimens, one with long

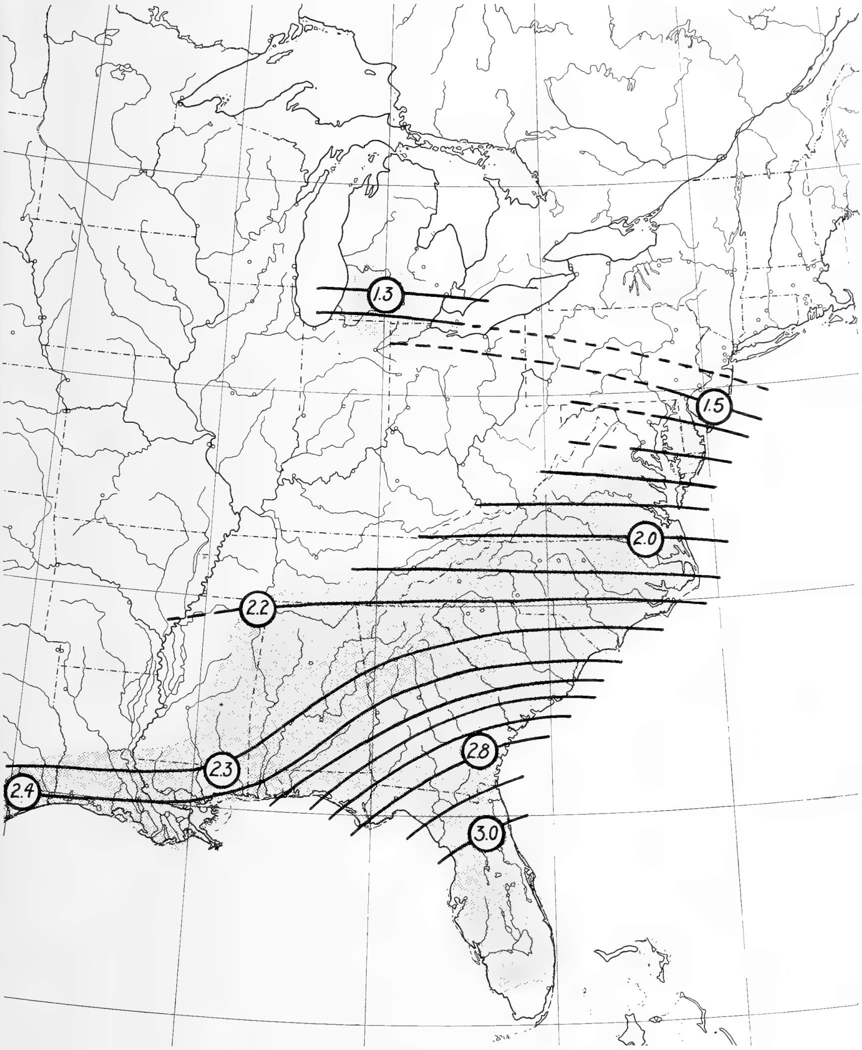


Fig. 7. Known geographical distributions of *Euptychia areolata* (Smith) and *E. mitchellii* (French) showing change in average of length/width ratios of spots 1–4 from north (1.3) to south (3.0).

spots, one with more rounded spots, and one with a reddish line surrounding the spots.

French (1889) described *E. mitchellii* as having four small spots on the forewing underside (circular in four examples, a little oval in two)

TABLE 3

DIMENSIONAL DATA ON FIGURED SPECIMENS OF E. AREOLATA AND E. MITCHELLII (a)

REFERENCE	SEX	STATE	#1 L	#1 W	#1 L/W	#2 L	#2 W	#2 L/W	#3 L	#3 W	#3 L/W	#4 L	#4 W	#4 L/W	#5 L	#5 W	#5 L/W	Av. 1–4 L/W	Spots on Forewing
E. AREOLATA AREOLATA																			
HOLLAND, 1931	♂	NOT STATED	16	5	3.2	29	11	2.6	27	12	2.1	30	13	2.3	Trace			2.5	Absent
DAVIS, 1924	–	FLORIDA	25	9	2.8	35	12	2.9	30	10	3.0	25	11	2.3	Trace			2.7	Absent
DAVIS, 1924	–	"	25	11	2.3	44	14	3.1	38	14	2.7	36	15	2.3	Trace			2.6	Absent
DAVIS, 1924	–	NO. CAROLINA	16	7	2.1	28	14	2.0	26	14	1.8	22	12	1.7	Trace			1.9	One
CLARK, 1932	–	FLORIDA	12	8	1.5	30	15	2.0	30	13	2.3	25	11	2.3	Trace			2.0	Absent
CLARK, 1932	–	TEXAS	30	11	2.7	50	21	2.4	40	22	1.8	41	17	2.4	21	12	1.7	2.3	One
KLOTS, 1951	♂	GEORGIA	25	9	2.8	35	12	2.9	27	9	3.0	33	12	2.7	13	7	1.8	2.8	Trace
EHRLICH + EHRLICH, 61	♂	TEXAS	20	9	2.3	44	16	2.6	40	16	2.5	37	14	2.6	24	7	3.6	2.5	Absent (b)
CLARKE, 1963	♂	NOT STATED	20	8	2.5	31	12	2.6	30	11	2.7	29	11	2.6	12	8	1.5	2.6	Absent
E. AREOLATA SEPTENTRIONALIS																			
DAVIS, 1924 (TYPE)	–	NEW JERSEY	6	4	1.5	14	9	1.6	15	10	1.5	8	6	1.3	Trace			1.5	Trace
CLARK + CLARK, 1951	–	VIRGINIA	20	9	2.2	31	15	2.1	30	14	2.1	22	12	1.8	Trace			2.0	Absent
CLARK + CLARK, 1951	–	VIRGINIA	12	6	2.0	25	12	2.1	22	12	1.8	23	10	2.3	Trace			2.0	Absent
E. MITCHELLII																			
BADGER, 1958 (c)	♂	INDIANA	17	12	1.4	21	21	1.0	22	20	1.1	22	19	1.2	15	11	1.3	1.2	Two
BADGER, 1958 (c)	♀	MICHIGAN	20	15	1.3	28	24	1.2	26	23	1.1	28	21	1.3	20	15	1.3	1.2	Four
BADGER, 1958 (d)	♂	INDIANA	20	15	1.3	30	21	1.4	30	19	1.6	32	19	1.7	20	12	1.7	1.5	Four (e)
BADGER, 1958 (d)	♀	MICHIGAN	21	14	1.5	31	26	1.2	32	23	1.4	31	21	1.5	24	15	1.6	1.4	Four (e)

(a) Length (L) and Width (W) given in 0.1-mm units.

(b) Figure as published is magnified × 1.6, measurements reduced proportionately

(c) "minimum development of ocelli."

(d) "maximum development of ocelli."

(e) Spot #6 for last two specimens: 14 9 1.6; 15 12 1.3, respectively.

and six on the hindwing underside (circular to slightly bulging), differing from *areolata* which may have from three to many elongate spots on the forewing and has five on the hindwing.

Davis (1924) described *E. areolata septentrionalis* from New Jersey as having the eyespots on the underside of the hindwing rounder (less elongate) than in those from Florida and the south in general, based on a comparison of 22 specimens from New Jersey with 28 from the south (7 North Carolina, 3 South Carolina, 17 Florida, 1 Texas). Davis added "The writer does not mean to imply that specimens from New Jersey may not occasionally show spots resembling those from Florida and Georgia."

Clark and Clark (1951) reported that both *E. a. areolata* and *E. a. septentrionalis* occurred in Virginia and that, at a locality about eight miles south of Suffolk, specimens of both races were taken. They wrote: "Most of the individuals were intergrades between the two, but some were typical *areolatus*, agreeing with specimens from South Carolina and Georgia, while others were equally typical *septentrionalis*, agreeing with specimens from New Jersey." They also stated that, in *E. a. areolata* the spots on the hindwing underside are "usually at least twice as long as broad, often much longer" while, in *E. a. septentrionalis*, these spots are "short and broad, from scarcely longer than broad to about twice as long as broad." Forbes (1960) referred to the spots on the underside of the hindwing in *a. areolata* as "elongate" and in *a. septentrionalis* as "shorter and more regular, perhaps half longer than wide." Davis (1924) in describing *septentrionalis*, said, simply "rounder," but illustrated specimens. There are at hand 12 published figures showing the underside of *E. areolata* and four of *E. mitchellii*. These were examined by the procedures used for the specimens; the results are given in Table 3; the length and width values are plotted in Fig. 8.

Through the courtesy of Mr. Charles F. Zeiger, I have a series of nine specimens (6 ♂ ♂, 3 ♀ ♀) taken by him at Orange Park and Jacksonville, Florida in May, 1959. The distribution of these with regard to spots on the forewing underside is: males, four with both spots absent, two with traces of the two spots; females, three with both spots absent.

The distribution of these nine individuals with regard to spot #5 on the hindwing underside is: absent in two males, a trace in one male and one female, large enough to measure in the remainder.

The dimensions and L/W ratios of measured hindwing spots 1–4 were found to be as follows:

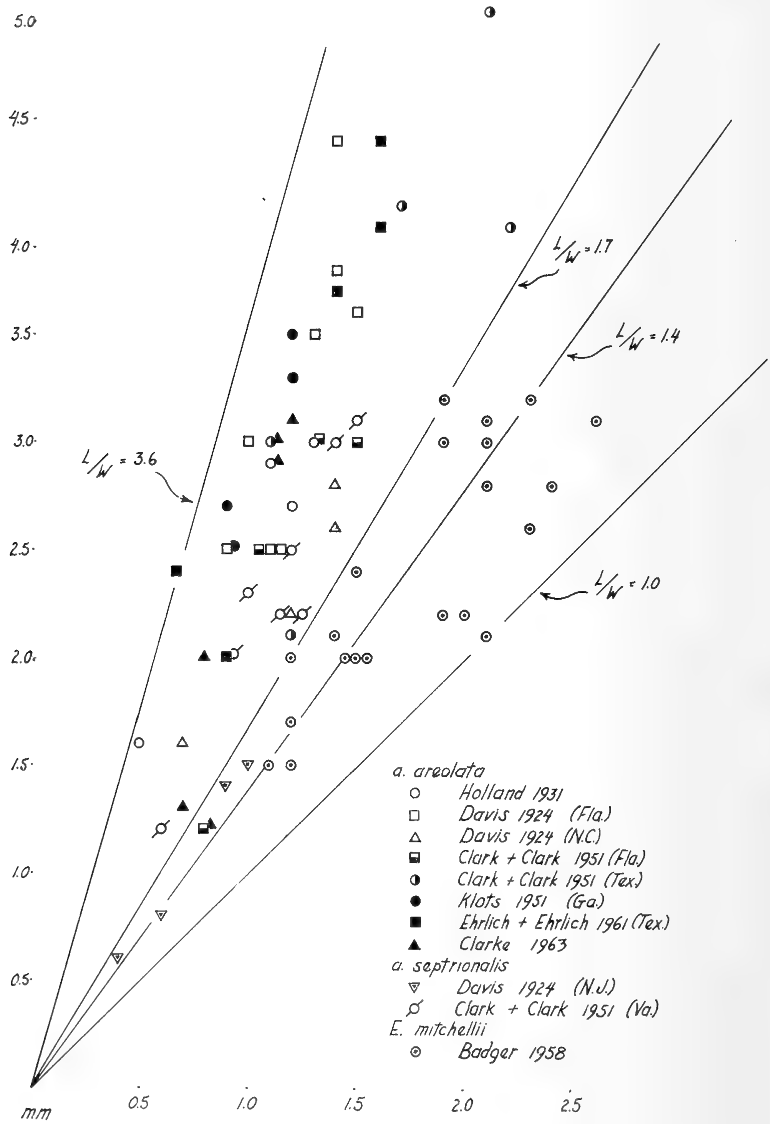


Fig. 8. Plot of length (vertical axis) and width (horizontal axis) of hindwing spots of 16 figured specimens of *Euptychia areolata* and *E. mitchellii* (French), showing range of L/W from 1.0 to 3.6.

	1			2			3			4			1–4
	L	W	L/W	L	W	L/W	L	W	L/W	L	W	L/W	L/W
♂♂	15	6	2.5	32	10	3.2	25	7	3.6	22	8	2.7	3.0
	14	7	2.0	32	12	2.7	30	12	2.5	35	11	3.2	2.6
	21	5	4.2	39	13	3.0	32	12	2.7	33	11	3.3	3.3
	23	8	2.9	39	12	3.3	30	10	3.0	34	10	3.4	3.1
	13	5	2.6	30	9	3.3	21	8	2.6	20	9	2.2	2.7
	20	5	4.0	29	10	2.9	22	10	2.2	24	10	2.4	2.9
													2.9
♀♀	12	6	2.0	40	11	3.6	35	10	3.5	33	10	3.3	3.1
	17	7	2.4	40	15	2.7	41	15	2.7	39	12	3.3	2.8
	25	6	4.2	40	11	3.6	33	9	3.7	32	10	3.2	3.7
													3.2

It will be noted that the spots range in elongation from L/W = 2.0 to 4.2, and the overall average is 3.0; these relations are shown in Fig. 9.

On the basis of the foregoing information, it would appear that the degree of elongation of the hindwing spots below undergoes clinal geographical variation somewhat as follows:

		L/W			
State	No.	Min	Max	Avg	Specimens from
Florida	9	2.6	3.7	3.0	*ex* coll. Zeiger
Florida	3	2.0	2.7	2.5	figured by Clark, Davis
Georgia	1	2.8	2.8	2.8	figured by Klots
Texas	2	2.3	2.5	2.4	figured by Clark, Ehrlich and Ehrlich
Mississippi	56	1.7	3.0	2.3	in collection Mather
North Carolina	1	1.9	1.9	1.9	figured by Davis
Virginia	2	2.0	2.0	2.0	figured by Clark and Clark
New Jersey	1	1.5	1.5	1.5	figured by Davis
Michigan–Indiana[1]	4	1.2	1.5	1.3	figured by Badger

[1] *E. mitchellii.*

This geographical variation is represented as L/W contours in the map (Fig. 7).

It appears that those previous writers who assumed that any of the populations under discussion were composed of individuals having a constant number of spots on the underside of either the forewing or hindwing were in error. French (1889) believed that *E. mitchellii* always had six spots on the hindwing below and *areolata* always had five. Two of the four *mitchellii* figured by Badger (1958) have five spots on the hindwing underside and two have six. The Mississippi sample of *areolata* includes specimens having four, five, and six spots on the hindwing below. The figure of *areolata* accompanying the original description is

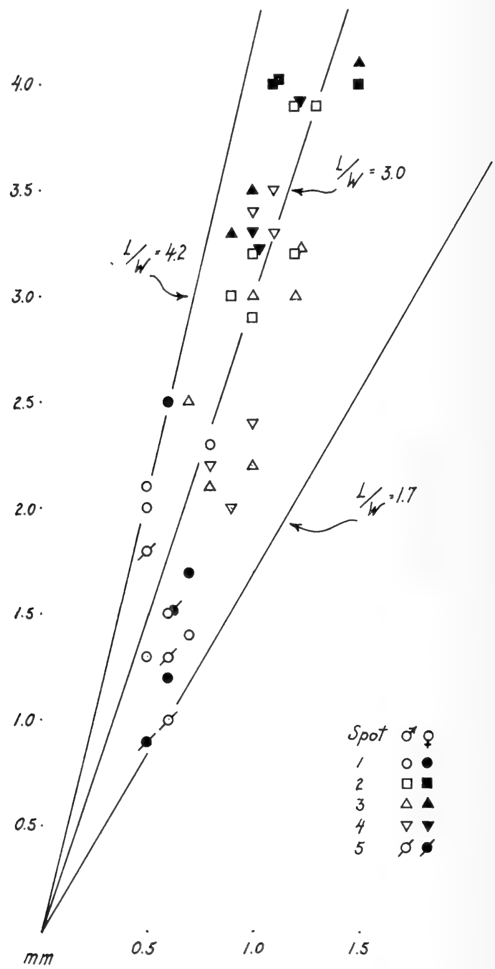


Fig. 9. Plot showing length (vertical axis) and width (horizontal axis) of hindwing spots of nine Florida specimens of *Euptychia a. areolata*, showing range of L/W from 1.7 to 4.2.

reported to be of a specimen having six spots. It is therefore suggested that, while there may be statistically significant differences in the frequency with which specimens occur having different numbers of hindwing spots in several populations, it is likely that any large sample will include specimens with four, five, and six spots on the hindwing undersurface.

The number of spots on the underside of the forewing in the Mississippi

sample ranges from none to four. The data suggest that the likelihood of fewer spots on the forewing increases southward. It would appear unlikely that specimens of the *mitchellii* population will be found with no traces of spots on the forewing underside although, as shown by Badger's (1958) male from Indiana, these spots may be greatly reduced.

The elongation of the spots on the hindwing venter clearly increases southward. It would appear that such spots in the *mitchellii* population in Michigan and Indiana would rarely have a L/W as great as 2.0 while those in the Florida–Georgia population would rarely have a L/W as small as 1.5. It would also appear, however, that specimens with hindwing spots having L/W in the range 1.5 to 2.0 could be taken anywhere within the entire range of all the populations under discussion. Davis (1924) seems to have had a more realistic view of these factors of geographical variation than was indicated by the comments of French (1889), Clark and Clark (1951), or most others who have written on the matter, since Davis did not contend that *all* individuals in the population he described were distinguishable from all of those making up the population with which it was being compared, nor did he endeavor to suggest, as did the Clarks, that those individuals occurring at a given locality resembling the average aspect of a population to which a name has been applied should be designated by that name, while others occurring at the same time at the same locality resembling another named population should bear its name.

Neither references to genetic studies nor speculations which may have been made to elucidate the factors involved in observed variation within and between the populations discussed above have been found. Ford (1945) discussed genetic and geographical variation with respect to size, number, and elongation of ventral hindwing spots in two satyrid species occurring in Great Britain. He noted (pp. 206–207) that in *Aphantopus hyperanthus*, the variety "*lanceolata*," characterized by an enlargement and distortion into ovals of the rings surrounding such spots, had been shown to be a simple recessive character, while variation manifested as reduction of size and number of ventral hindwing spots, found to be commoner in some districts than in others, was controlled on a multifactorial basis (pp. 222–223). He noted that in *Coenonympha tullia*, there is geographic, clinal variation from an almost unspotted race in the north (Scotland) to a race with well-developed spots southward (pp. 292–293). It would appear that the *areolata–mitchellii* complex could provide an excellent basis for studies of factors influencing variation.

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TYPE LOCALITY OF *CERCYONIS STEPHENSI* REVISITED

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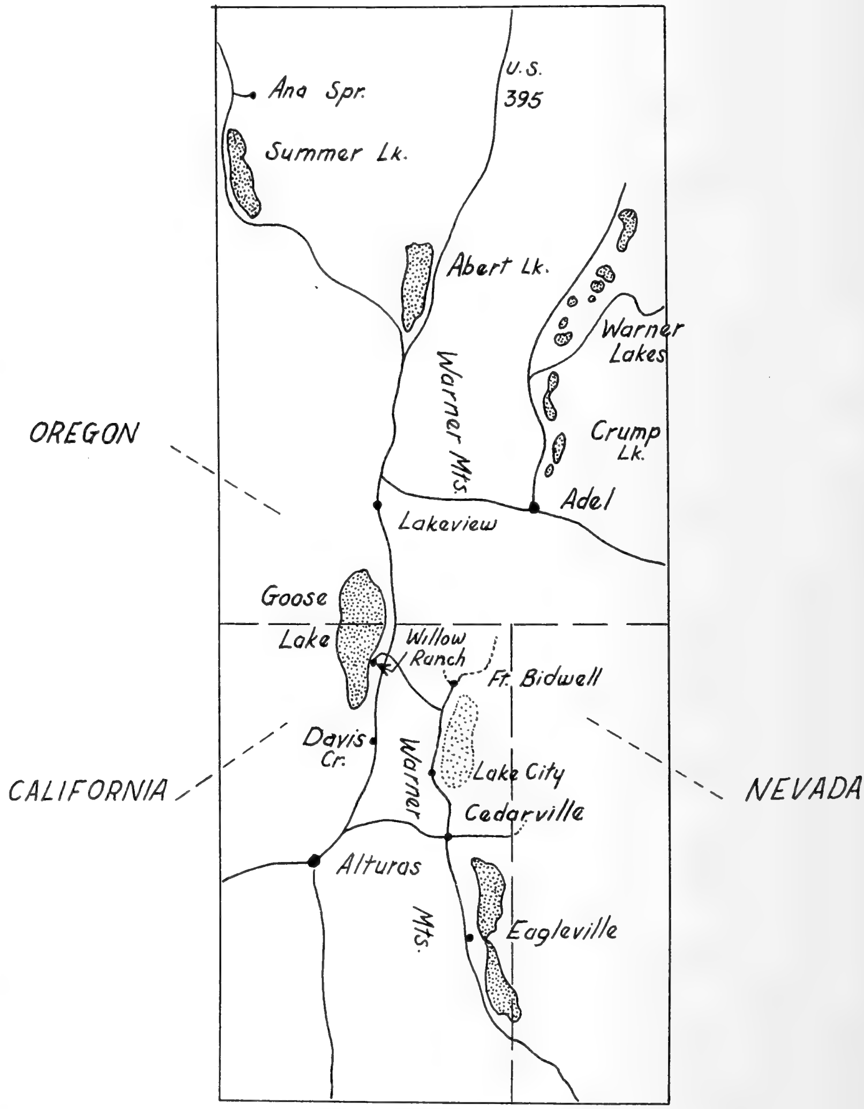
W. G. Wright described *Satyrus stephensi* on page 184 of The Butterflies of the West Coast in 1905. He gave the type locality as "Northeastern California." The type specimens had been collected in 1894 by Frank Stephens. Dr. John A. Comstock investigated this form in the early 1920's and published a paper on it (Bull. So. Calif. Acad. Sci., 23: 13, 1924). He had collected specimens in Modoc County in the vicinity of Goose Lake. He noted that Wright did not describe *stephensi* until 11 years after the specimens were taken, and that they had been exposed to daylight during that time, so that the figures in Wright's book are too light. He also pointed out that figure 249 is a female and not a male, as Wright had labeled it. Comstock considered *stephensi* to be a female form of *Cercyonis ariane* (Boisduval) (now *C. pegala ariane*), and it has been so classified by most subsequent writers.

Comstock quoted Stephens as writing that he caught the types "a few miles from the Nevada line and some thirty miles south of the Oregon line." This would put the locality somewhere between Davis Creek and Alturas. It is very doubtful whether Stephens got over east of the Warner Mountains in what is now called Surprise Valley; Comstock does not indicate that Stephens got over there. Probably that area was relatively inaccessible then, although the settlement at Fort Bidwell dates back to the 1860's.

Now, not only does the paved U. S. Highway 395 traverse the area from north to south, but there is also a paved road going east over Cedar Pass to Cedarville, in Surprise Valley. In addition, there is another road, partly paved, going over Fandango Pass into the Valley, and a paved road in the Valley running from Fort Bidwell to the southern boundary of Modoc County. That part of the country is dominated by the Warner Mountains, an isolated range extending north and south about 70 miles in California and 30 miles in Oregon. Eagle Peak, in Modoc County, reaches up to almost 10,000 feet and there are a dozen other peaks higher than 8,000 feet. The valleys below, on each side of the range, vary from 4,500 to 5,000 feet, and on both sides there are lakes. In California, there are three on the east side, Upper Lake, Middle Alkali Lake, and Lower Lake. In Oregon there are the Warner Lakes, extending from Pelican Lake, near Adel on the south, to Bluejoint Lake on the north. These lakes are fed by streams coming out of the Warner Mountains. On the west side there is a single large lake, Goose Lake, which stretches for 25 miles,



EXPLANATION OF MAP

Sketch map of the Warner Mountain area. Scale: One inch equals 20 miles.

two-thirds of it in California and the rest in Oregon (see map). The water level of these lakes varies, depending on the snowfall in the mountains; and the shores are often marshy and bordered by wet meadows and irrigated hay fields. The meadows especially are the home of

Cercyonis. Annual precipitation is 12 to 15 inches west of the mountains and about seven to eight inches east of them.

This country is mostly devoted to raising hay and livestock; and most of the land is privately owned and fenced with wire mesh. This makes collecting difficult and limited mostly to the roadsides and the occasional meadow with only barbed-wire fencing.

In July, 1964, I crossed the Warners over Fandango Pass, entering Surprise Valley six miles south of Fort Bidwell. Just before reaching the valley floor I stopped to examine a rather dry pasture with clumps of wild rose and other bushes scattered over it. Here I found *Cercyonis pegala ariane* (Boisduval), following Comstock's characterization of this subspecies, but there were only males. They agree well with Wright's figure 250, and with Comstock's figures of *ariane*, one of which came from near Fort Bidwell. I then looked for possible collecting places between Lake City and Cedarville. About five miles north of the latter place a road goes east to Leonard's Hot Springs. Sweet clover bordered this road and there was a pasture with clumps of wild rose in it. Here I took more males of *ariane* and also a mating pair, the female, a beautiful, recently emerged individual of the form *stephensi*, the male, *ariane*. It was evidently a bit early for the females, being July 17, but it augured well for the return trip some days later.

Coming northward after five rather warm days, I found males plentiful in the pasture north of Cedarville and also took several females there. At the Fandango Pass location, I found them even more numerous. They flitted about, often coming to rest in the bushes, but they could be captured on the wing, the females especially having a rather slow flight.

That afternoon I examined the area around Davis Creek but found nothing. At Willow Ranch, about 12 miles north of Davis Creek, I took several males, but no females.

Next morning I went out to the Warner Lakes, in Oregon, and located a collecting site 10 miles north of Adel near the north end of Crump Lake. Here there was a large, marshy meadow near the road; *ariane* was flitting about, often lighting on the high stems of grass or reeds, and females were numerous.

After spending an hour and a half there on each of two mornings, I had about 25 males and 40 females of *C. p. ariane*, most of them in beautiful condition. So, on the second day I proceeded to Ana Springs, north of Summer Lake, arriving there about 3:00 P.M. I had stopped there on the trip southward, but, as in California, had found only males. The locale there is a rather small marsh about two miles east of Ana Springs (*ariane* also occurs at the Springs, but only sparingly). Males

and females were fairly numerous, and I managed to take about 35 of the butterflies.

In addition to these localities, *ariane* occurs in the Carson Valley, south of Carson City, and I took a few males there. I also took a few males at Chandler State Park, north of Lakeview, in Oregon. The species no doubt occurs in many other places in that area, such as south of Cedarville, around Davis Creek, around the north end of Goose Lake, probably throughout the Warner Lakes area, around Summer Lake, and possibly also Abert Lake.

Looking at the entire catch of 155 specimens (82 males and 73 females), it is evident that there is a great deal of variation. Males are quite uniformly dark; some individuals have yellowish areolas around the dark ocelli on the upperside and others do not; and the number of ocelli on the hindwings varies from one to four. Females vary from rather dark with only a little yellowing around the primary ocelli, to quite light with a wide yellow band on both wings. The latter can be called typical *stephensi*. From the somewhat limited material at hand, I find that the percentages of females which represent the *stephensi* form are 88% in Surprise Valley, 25% at Crump Lake, and 62% at Ana Springs.

I also paid some attention to the other species of *Cercyonis* in this area. I have taken *C. silvestris* (Edwards) along the road some miles south of Eagleville in Surprise Valley, near Crump Lake, and near Picture Rock Pass, just north of Ana Springs, in each case in rather dry areas on the blossoms of rabbit brush (*Chrysothamnus*). *C. oetus* (Bdv.) has been taken, also on rabbit brush, at Lake City and in Fandango Valley, in California; in various places in the Warners in Oregon; in the Hart Mountain Antelope Refuge; and at numerous other places farther north in Oregon.

BOOK NOTICE

MICROLEPIDOPTERA OF JUAN FERNANDEZ ISLANDS. By J. F. Gates Clarke. Proc. U. S. National Museum, vol. 117, pp. 1–106, 111 text figs., 1 plate. 1965.

A total of 71 species are treated from this island group, which is located some 400 miles off the coast of southern Chile. Included are 41 previously undescribed species, primarily pyraloids, and eight new genera. Of the total, ten are widespread moths which are associated with activities of man and presumably are introduced, while only five others have been recorded in adjacent portions of South America. Clarke points out that the high endemism (about 75%) is probably disproportionate, in part a product of the preliminary state of knowledge concerning Microlepidoptera both in the islands and in mainland Chile and Argentina. Some 28 species known only from the archipelago are pyraloids of the family Crambidae, the only group which seems to have undergone extensive speciation in the Juan Fernandez Islands.—EDITOR.

MIMICRY AND DISTRIBUTION OF *CAENURGINA CAERULEA* GRT. (NOCTUIDAE)

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The color blue occurs in several families and subfamilies of moths but only in a very few species. These few usually exhibit one or more additional prominent colors. For example the Nearctic species *Alypiodes bimaculata* (H.-S.), has bright yellow spots on the forewing in addition to a patch of metallic blue scales. The Australian species *Agarista agricola* Donov. is also very conspicuously mottled with red and yellow colors besides the blue. Sometimes the blue color fades after death, so that patches of blue in the forewings of *Paramiana laetabilis* (Sm.) only appear in fairly fresh specimens.

With the rarity of the color among these insects, it is somewhat puzzling to note the predominently blue *Caenurgina caerulea* Grote.[1] Its near relatives are brownish or dark-colored, and only *C. distincta* Neum., which has a slight bluish cast, tends to bridge the hiatus between *caerulea* and the other members of the genus. The key to understanding the evolution of the blue color in *caerulea* will probably not be found through study of pigmentation tendencies within the *Caenurgina*, but through study of other factors. My first field observations of *caerulea* may have provided that key. Many additional observations of the living animal in its habitat support my original opinion, which is that *caerulea* may be a mimic of the common blue butterfly, *Plebejus* (*Icaricia*) *icarioides* (Bdv.).

While collecting numerous specimens of *Plebejus* over an extended patch of lupine plants, I ended up once with *caerulea* in my net. At first I thought the chased "butterfly" had escaped and the moth was an accidental capture. It was only after several such incidents that I realized that I was being deceived by the moth's coloration and by its particular manner of flight.

Much debate has centered on mimicry and what, precisely, the term implies. But regardless of the term used, structural and behavioral resemblance between *Plebejus icarioides* and *Caenurgina caerulea* occurs and should be considered further. The original observations were made at Fawn Lodge near Weaverville, Trinity County, California. I have

[1] This species is figured in color by Holland (1922, The Moth Book, Plate 30, Fig. 13), where it can be contrasted to the more somber-colored members of the family shown on the same plate.

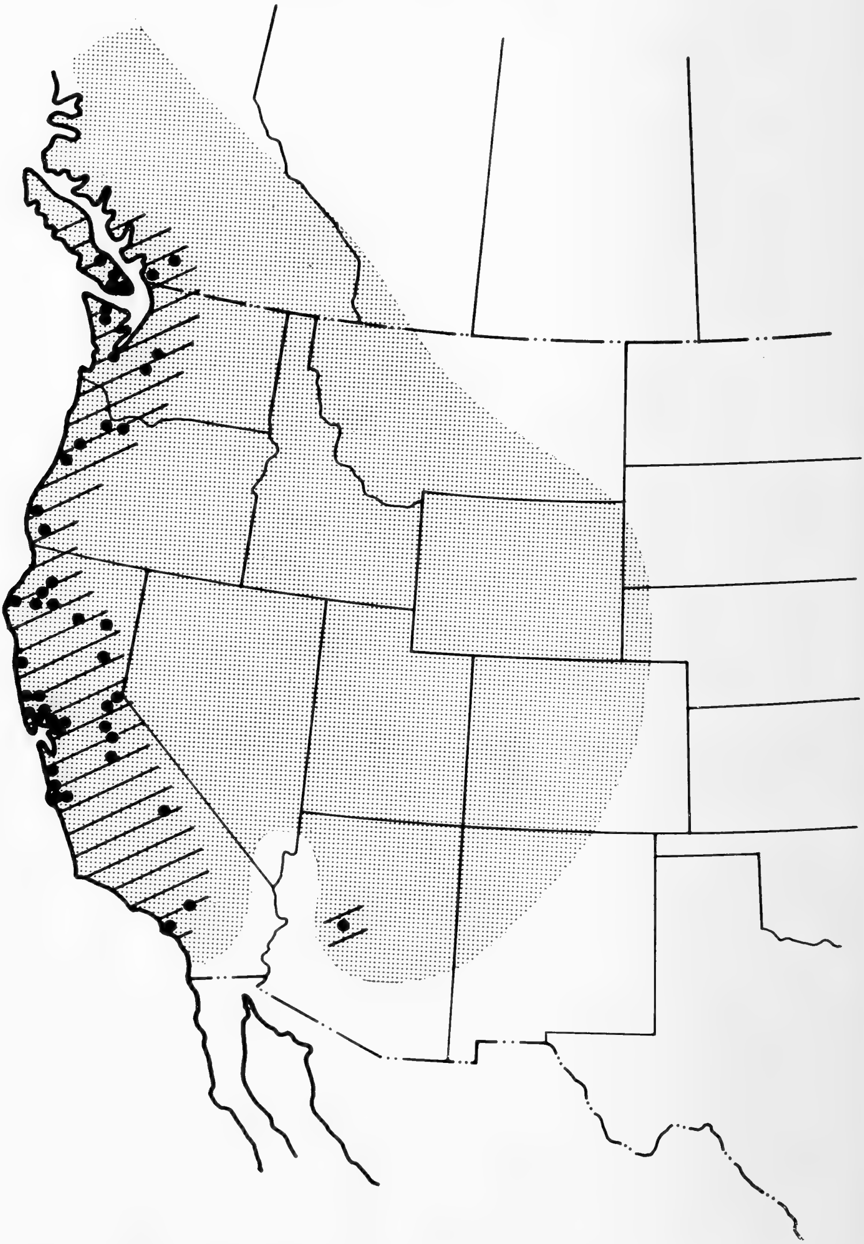

Plate 1. Map of western North America showing the distribution of *Caenurgina caerulea* Grt. (black circles) and *Plebejus icarioides* (Bdv.) (stippled area) and the general area where they are sympatric (oblique slashes).

since observed both moth and butterfly in Humbolt, Plumas, and Trinity counties, California.

The moth apparently feeds on the same lupine host plant as the butterfly: *Lupinus latifolius* Agardh. at Weaverville, and *L. formosus* Greene at Butterfly Valley, Plumas County, California. As one walks through scattered clumps of lupine, both the moth and butterfly take flight. These flights are usually short, particularly those of the moth. I know of only a few occasions when a moth took flight without my having first disturbed it, and they may have been otherwise alarmed. In other words, I am not certain of the diurnal activity of the moth, beyond the knowledge that it is found around the lupine plants during the day, and will take to wing readily. W. R. Bauer (*in litt.*) reports that he has taken *caerulea* at lights at night, but this is not surprising if it is ordinarily diurnal, for diurnal butterflies sometimes occur at lights also.

The resemblance between the moth and butterfly is not exact, particularly when two specimens are placed side by side. The blue color in the dead moth gradually fades so that the contrast between the two species may increase in pinned material. This indicates that the blue in the moth is a pigmentary rather than a structural color. The dorsal forewings in *caerulea* are somewhat darker than the hindwings, and the linear scaling on this part of the wings breaks up the pattern by countershading. Perhaps since the forewings cover the hindwings when at rest, they afford some protective (concealing) advantage to nonflying specimens. When flying however, the blue color is very obvious, and together with the flight behavior mentioned above, the resemblance of the moth to *icarioides* is pronounced.

Other species of blue butterflies besides *icarioides* occasionally fly over and around the lupine fields including *Plebejus* (*Lycaeides*) *melissa* (Edw.), its sibling *P. argyrognomon* (Bergst.) and *Glaucopsyche lygdamus* (Dbldy.). The latter species is known to utilize lupine in other areas and is not uncommon where *icarioides* flies so that presumably it could also act as a model for *caerulea*.

The published accounts of the distribution of *C. caerulea* usually list only the "western United States" or "Pacific Coast." Since the distribution of mimic and model is important to the concept of mimicry, a comparison of the ranges of the butterfly and moth are presented in the map (Plate 1). Reference to the map shows that the known distribution of the moth falls well within the range of the butterfly.

The following data summarize the known distribution of *caerulea* and indicate the location of these records in the various collections and museums. The following abbreviations are used for these collections. I

am grateful to these museums, and to the researchers indicated below for help in this problem: AMNH—American Museum Natural History (F. H. Rindge); CAS—California Academy of Sciences (C. D. MacNeill); CIS—California Insect Survey, Berkeley (J. A. Powell); JF—John Franclemont collection; LACM—Los Angeles County Museum (Lloyd Martin); SIU—Southern Illinois University; USNM—U. S. National Museum (E. L. Todd); WB—William Bauer collection. The work was supported by the National Science Foundation, grant GB-2423. My thanks also to R. E. Blackwelder and W. G. George for help with the manuscript.

Arizona. *Yavapai Co.*—(AMNH). (This specimen is from the Buchholz collection, presumably collected by him. The disjunct nature of his record suggests a need for verification.) British Columbia. Corfield (AMNH), Fitzgerald (LACM), Goldstream (USNM), Mt. Benson (USNM), Quamichan Dist., Vanc. Is. (USNM), Shawnigan Lake (USNM), Vancouver (AMNH), Victoria (AMNH), (USNM), Wellington (AMNH). California. *Alameda Co.*—(CAS), (USNM), Berkeley (AMNH). *Contra Costa Co.*—(CAS), Bollinger Canyon Rd. (CIS). *Eldorado Co.*—Grizzly Flat (AMNH). *Humbolt Co.*—Willow Creek (SIU). *Kern Co.*—Havilah (AMNH). *Lake Co.*—Anderson Springs (LACM), (JF). *Lassen Co.*—(AMNH). *Los Angeles Co.*—near Los Angeles (LACM). *Madera Co.*—Bass Lake (AMNH). *Marin Co.*—(CAS), Alpine Lake (AMNH), (CIS), Fairfax (AMNH), (LACM), Lake (LACM), Tomales (WB). *Mariposa Co.*—(CAS), Inspiration Point, Yosemite (USNM), Road to Nevada Falls, Yosemite (USNM), Yosemite Valley (USNM). *Mendocino Co.*—(CAS), Anchor Bay (LACM), (WB), (JF), 16 mi E of Manchester (CIS), near McDonald Mtn. House (CIS), Yorkville (LACM). *Monterey Co.*—(AMNH), (CAS), Big Sur (LACM), Pacific Grove (USNM). *Napa Co.*—(CAS). *Placer Co.*—(AMNH), Dutch Flat (SIU), Mt. Tahoe (USNM). *Plumas Co.*—(AMNH), (CAS), (USNM), Butterfly Valley (SIU), Johnsville (WB), (JF), Mohawk (WB). *San Francisco Co.*—San Francisco (AMNH). *Santa Clara Co.*—Stanford Univ. (LACM). *Santa Cruz Co.*—(CAS), Scotts Valley (AMNH). *Shasta Co.*—(CAS), Hat Cr. (CAS). *Siskipou Co.*—Bartle (AMNH), Dunsmuir (AMNH), 3 mi S Dunsmuir (CIS), Shasta Retreat (USNM), Shasta Valley (AMNH). *Sonoma Co.*—Kenwood (JF), Plantation (CIS), 4 mi W Plantation (CIS), Sonoma (AMNH). *Trinity Co.*—(CAS), Carrville (LACM), Fawn Lodge nr. Weaverville (SIU). *Tulare Co.*—(CAS), Crescent Mdw. to Hamilton Lake, Sequoia Nat. Park (LACM), Mineral King (AMNH). *Tuolumne Co.*—Sonora (CAS), N Fk. Tuolumne River (CAS), Twain Harte (CAS). Oregon. *Benton Co.*—Corvallis (CAS), (AMNH). *Clackamas Co.*—Estacada (CAS), Gov't Camp, Mt. Hood (CAS). *Curry Co.*—Port Orford (AMNH). *Klamath Co.*—(CAS). *Lane Co.*—Reed (CAS), (USNM). Washington. *Clallam Co.*—Port Angeles (USNM). *Jefferson Co.*—Hurricane Ridge, Olympic Mtns. (AMNH), *Kittitat Co.*—Easton (USNM). *Pierce Co.*—Longmire Spgs., 2,500 ft, Mt. Ranier (CAS). *Thurston Co.*—Olympia (USNM).

The times of initial adult emergence of *caerulea* and *icarioides* and their seasonal flight times as determined by dates on museum specimens also overlap except in one or two instances. An Arizona record of the moth, which may be erroneous, and a record from Wellington, British Columbia, give August dates of capture. Though *icarioides* occur in August in Arizona, the northern record seems quite late. However, in all cases where late collecting records occur for the moth, the multivoltine *G.*

lygdamus has also been noted. In other words, the geographic range and the temporal distribution of the moth fall within the known range of the butterflies.

One objection to the theory of mimicry has been the casual and anecdotal nature of the evidence. While not wishing to argue about the value of certain evidence, I find it extremely difficult to determine by field observations what "protective" is, let alone the extent of the supposed protection. Not only may a subjective evaluation of an observation be fallacious, but man's observation of predator and victims in the field may be a rare thing. As a matter of fact, I have not observed a bird chasing or feeding on *Plebejus icarioides* or *Glaucopsyche lygdamus*, the lycaenid models chiefly involved in the suspected mimicry by the moth. This is not to say that bird predation does not occur. I have observed birds chasing other species of blues, and Price (1961) has observed not only birds but flying insects preying on adult butterflies. Powell and Stage (1962) report *icarioides* among the prey records for robberflies in the White Mountains, California. Many other animals, such as spiders and ambush bugs, feed on adults of blues.

It has often been noted that predators utilize prey in direct proportion to the abundance of the latter. Both of the above species of blues can be considered common, and though their concentration is localized by the spotty, semi-clumped distribution of the lupine host plants, adults are usually quite numerous. The moth is comparatively less abundant.

Other observations may serve as an index of predation in the butterfly populations. When disturbed specimens of *P. icarioides* flee away on their highly erratic "escape" flight, they may suddenly fold their wings together, drop to the ground, and feign death. This action is thought to have survival value to escape capture in flight. Not all disturbed specimens feign death, but the occurrence of this behavior indicates that the species has been subject to predation for a considerable time. The moth likewise terminates disturbed flight by quickly dropping to the plant substrate. Erratic flight and quick landings are common characteristics of diurnal moths; but since the regular flight of *caerulea* is so similar to that of the butterfly, we may assume that the abruptly terminated flight noted here, presumably for the same protective function, reinforces the resemblance between the two species.

We may further assume that even though they are preyed upon, the rarity of sightings might be due either to the rarity or particular food preferences of the predator, or to a protective adaptation in the prey. It is possible that the alkaloids known to be concentrated from the soil by the lupine host plants occur in the tissues of the butterflies. These

chemicals could render the adults distasteful to some predators with catholic tastes, so that they avoid blue-colored insects. In other words, the blue could offer a selective advantage in being an aposematic color. To this extent it is possible that the noctuid moth is likewise distasteful to certain predators, and the resemblance of the moth and butterflies classified as a type of Mullerian mimicry. That the resemblance is not very exact, as is expected in other forms of mimicry, also suggests a Mullerian type.

It might be argued that blue colors in the Lepidoptera accentuate the conspicuousness of the possessor. Oftentimes the selective advantage of the prominent color can be guessed: sexual attraction, warning, and flashing colors for protection, etc. The fact that most of the blue is on the dorsal surface in butterflies, while the undersurface which is exposed in resting specimens is cryptically colored, reinforces the advertising nature of the blue. In moths, where cryptic colors often occur on the exposed dorsal surface, blues are less frequently encountered, and when present, they add to the conspicuousness of the specimen.

The suggestion might also be entertained that something about the size, shape, or flight behavior other than the color affords an advantage to the butterfly. Since these features are also approximated by the moth, in addition to the color, any or all could promote the resemblance between the species by selection. Of course, both species could be evolving toward a particular ecological niche, or be exhibiting a common response to environmental selection, so that the similarity may be convergent rather than mimetic. I hope that lepidopterists in western North America will make additional field observations as opportunity arises, and clarify the resemblance between *caerulea* and *icarioides*.

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CORRECTION

In the article "The maintenance for experimental purposes of form 'sulphurea' of *Pieris napi* (Pieridae)" published in Volume 18, No. 2 of this journal, the following erratum should be noted. In figure 4 on page 99, the genotype of the "pale yellow" at the top right-hand corner should be S^pS^h, not S^pS^p as printed.—S. R. BOWDEN, *Redbourn, St. Albans, Herts., England*

SOME UNUSUAL BUTTERFLY RECORDS FROM CENTRAL CALIFORNIA

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The year 1963 in central California, marked by heavy rains from March through May in the lowlands and snows lasting into July in the Sierra Nevada, produced a very rich season for butterflies, although it was as much as six weeks late in some areas. Some of the unusual records resulting from the author's collecting are described in this paper.[1]

Plebejus saepiolus (Boisduval)

A trip to the dry portion of the San Bruno Hills overlooking Brisbane, San Mateo County, on 11 June, to collect typical *Speyeria callippe callippe* (Boisduval) also yielded a single female of *Plebejus saepiolus*. The specimen possesses considerable blue basal scaling, although not as much as is present on specimens from the Plantation area in Sonoma County to the north, at an elevation of about 1,000 feet. No other records of *P. saepiolus* from the San Francisco peninsula region are known to the writer; none could be located in the American Museum of Natural History.

Lycaena xanthoides (Boisduval)

A male of *L. xanthoides* which is unusual in coloration was collected on the same trip to the San Bruno Hills. The forewing is bright orange on the underside, while the hindwing is gray on the underside, far darker than any other *xanthoides* seen by the author in the San Francisco Bay area or in the American Museum collection. Many of the spots of the underside of the hindwing tend towards obsolescence. Deepening of the ground color with greater abundance of melanins are tendencies correlated by Hovanitz (1941) with butterflies' occurrence in cold, moist areas. Possibly the cool, foggy summer conditions characteristic of the San Bruno Hills play a role in alteration of the phenotypic expression of certain butterflies there.

Incisalia fotis doudoroffi dos Passos

A single specimen of *Incisalia fotis* was collected on Chew's Ridge, south of Jamesburg in the Santa Lucia Mountains in Monterey County,

[1] For clarity, all nomenclature follows the recent list of dos Passos (1964).

at an elevation of about 5,000 feet, on 29 June. The specimen corresponds closely to the race *doudoroffi* found at Carmel and Big Sur, coastal localities in Monterey County. The Santa Lucia Mountains site is about 30 miles inland from Big Sur, and the collection evidently represents an elevational and geographical range extension for *doudoroffi.*

VANESSA CARDUI (Linnaeus)

A single, very fresh male of this species was taken at Chew's Ridge along with the preceding species. As no great migration of this species was reported in the season summary for 1963 in central California, and the *cardui* seemed freshly emerged, it seems likely that it appeared in the Santa Lucia Range from a breeding stock rather from migratory movement from the south. This contrasts with the opinion of Abbott (1962) that *V. cardui* overwinters irregularly, if ever, as far north as central California.

POLYGONIA FAUNUS RUSTICUS (Edwards)

Garth and Tilden (1963) report only a single rather ill-defined record for this species in the Yosemite Park area, an old specimen labeled merely "Yosemite," 26 June. However, *P. f. rusticus* seemed quite common on 17 May 1963, at the northwest entrance to the park on the Big Oak Flat road, at an elevation of about 4,000 feet, where it was flying with *P. zephyrus* (Edwards). Thus, *rusticus* seems to be a bona fide member of the Yosemite Park Lepidoptera fauna.

SPEYERIA CALLIPPE JUBA (Boisduval)

A minor aberration of *S. callippe juba* was taken along the North Fork of the Tuolumne River, Tuolumne County, on 26 July. A large assemblage of *Speyeria*, including *zerene* (Boisduval), *hydaspe* (Boisduval), and *callippe*, was sampled at the locality, which is about four miles northeast of the town of Tuolumne (near Camp 8). The aberrant individual has the basal and median spots between veins Cu_2 and 2^dA on the underside of the hindwing fused together. Examination of the specimens of all species of *Speyeria* in the American Museum collection did not reveal another example comparable to this striking aberration.

EUPHYDRYAS EDITHA NUBIGENA (Behr)

Unusually lightly marked specimens of *E. e. nubigena* and other species appeared to be present in exceptional numbers during late July at moderate elevations in Tuolumne County. A colony of *E. editha* was

discovered about one mile southwest of the Clark's Fork turnoff on Highway 108 (just west of Dardanelles). Although visits were made to the site on three consecutive days (26–28 July), the terrain was too formidable to permit extensive collecting, and only butterflies on or near the road could be captured. This is regrettable because the specimens taken show a high incidence of aberrant coloration. Single individuals of the typical form (Fig. 1) were captured 26 and 27 July. These two compare closely in size and maculation with a typical male taken two weeks later and 4,000 feet higher, at Sonora Pass. A partially orange-suffused male (Fig. 2) was also captured 27 July; it approximately matches the most extreme specimens in the large collection of *nubigena* at the American Museum of Natural History. Two additional specimens taken on 26 July (Fig. 3, ♂) and 28 July (Fig. 4, ♀) correspond closely to the named aberration *rubrosuffusa* Comstock, described from the Mammoth Lakes area in Mono County, California.

Although this sampling of the Clark's Fork colony is too small to be of real significance, it is tempting to suggest that it might be representative of phenotypic variation extant at the time. The five specimens were captured on three different days, in morning, noon, and late afternoon. Further information is provided by J. C. Montgomery (*in litt.*) of Redwood City, California, who in a previous year during mid-July collected a number of *editha* from a colony at Dardanelles, at an elevation of about 6,000 feet. This locality is also on Highway 108, but at a large meadow along the Stanislaus River, about three miles from the Clark's Fork site. Montgomery's specimens also tend to be relatively light and orange-washed, although not averaging as much so as the examples illustrated (Figs. 3, 4). It is possible, as Mr. Montgomery suggests, that colonies of *E. editha nubigena* from moderate elevations characteristically tend toward the orange-suffused form. There may well be other forces acting, since a number of unusually light or orange-washed specimens representing *Melitaea palla* Boisduval (see Fig. 5, typical, and 6, light example from Clark's Fork, taken together), *Vanessa virginiensis* (Drury), *Polygonia zephyrus* (Edwards), *Oeneis chryxus stanislaus* Hovanitz, and *Papilio zelicaon* Lucas, were captured in the general area of the *editha* colony on 26–28 July. This suggests that the "aberration" tendency may have been caused by climatic conditions during the earlier part of the same generation. The weather at moderate elevations in the central Sierra Nevada was moderately warm during May, 1963, and it is possible that most of the above-mentioned species could have undergone normal larval stages at that time. However, cold weather with heavy snows followed during June. Whether this climate sequence had any connection with the number of light and orange-washed specimens captured in the

area in rather casual collecting during the three-day period in late July could be tested under properly controlled systems in the laboratory, or by assiduous collecting in the Sierra Nevada at moderate elevations in years similar to 1963.

Euphydryas chalcedona sierra (Wright)

A substantial colony of *E. c. sierra* was discovered unusually late in the season on the very summit of Mt. Tallac, above Lake Tahoe, at an elevation of 9,900 feet, with only fresh males in evidence despite the date, 22 August. A colony of *E. sierra*, which normally has its peak flight in July, exists in Glen Alpine Creek below Mt. Tallac at an elevation of 6,500 feet, and the species was unexpected at the summit in late August. Other species flying at Mt. Tallac included *Oeneis chryxus ivallda* (Mead) (fresh to worn) and various *Vanessa*, but no *E. editha nubigena*, the expected *Euphydryas*, were observed.

A very small *Euphydryas* taken in the Sonora Pass area (elevation 9,800 feet) on 28 July, at first was presumed to be *E. nubigena*, but was later determined to be a dwarfed individual of *E. chalcedona sierra*. Collected at an unusually high altitude, this specimen measured 8 mm less in wingspan than the average of 37 mm exhibited in the series taken from Mt. Tallac one month later (see Figs. 7, 8). The relationships between the various named and unnamed forms of *E. chalcedona* in the central Sierra Nevada are indeed complex, and like many specimens, the Sonora Pass individual does not seem to fit any well-known pattern. Another very worn specimen, probably assignable to *E. chalcedona sierra*, of natural size and somewhat orange-washed, was also taken in the Sonora Pass area on 21 August.

Acknowledgments

The author is indebted to the American Museum of Natural History, and particularly to Drs. F. H. Rindge and J. C. Pallister, for assistance in working with the fine collection housed therein; and to Dr. O. E. Sette, Los Altos, California, J. C. Montgomery, Redwood City, California, and Dr. P. R. Ehrlich, Stanford University, for helpful data and general assistance with this report.

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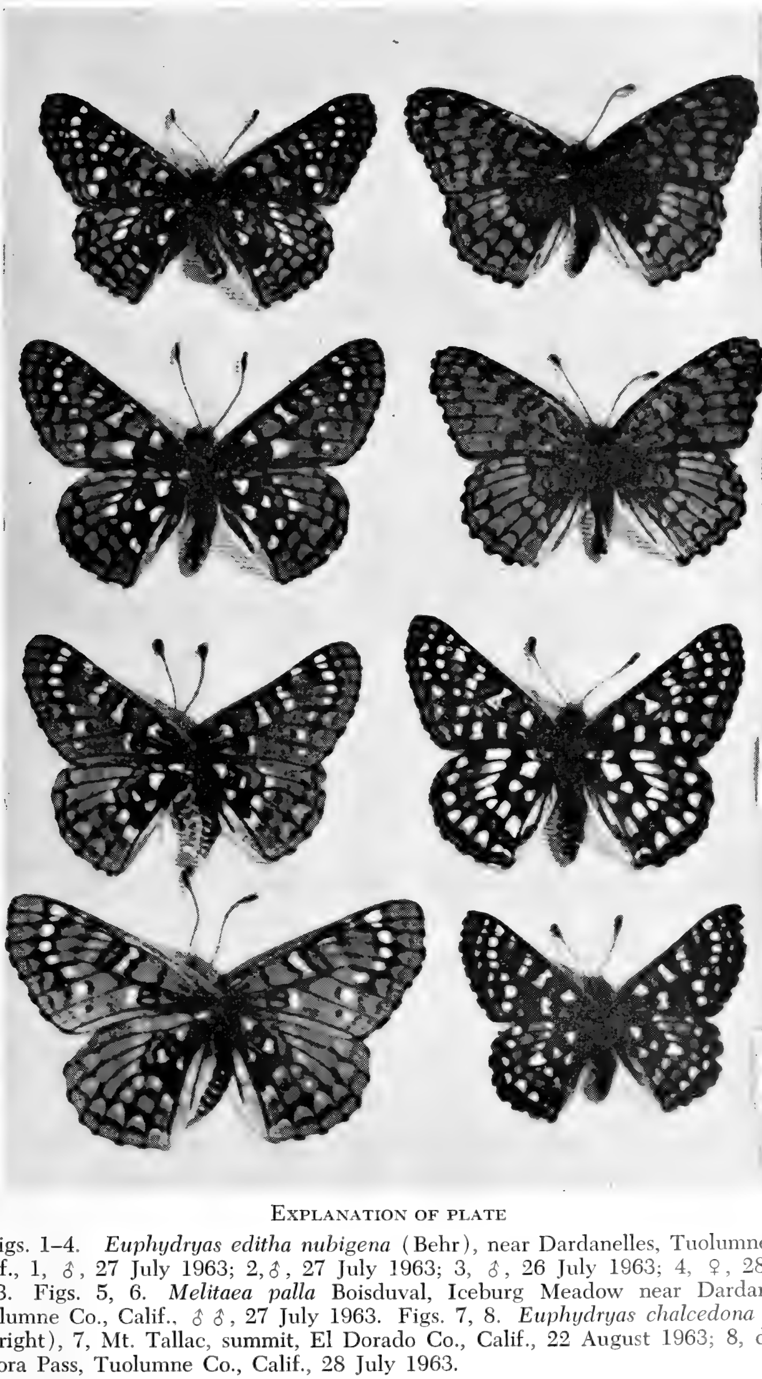

Explanation of plate

Figs. 1–4. *Euphydryas editha nubigena* (Behr), near Dardanelles, Tuolumne Co., Calif., 1, ♂, 27 July 1963; 2, ♂, 27 July 1963; 3, ♂, 26 July 1963; 4, ♀, 28 July 1963. Figs. 5, 6. *Melitaea palla* Boisduval, Iceburg Meadow near Dardanelles, Tuolumne Co., Calif., ♂♂, 27 July 1963. Figs. 7, 8. *Euphydryas chalcedona sierra* (Wright), 7, Mt. Tallac, summit, El Dorado Co., Calif., 22 August 1963; 8, dwarf, Sonora Pass, Tuolumne Co., Calif., 28 July 1963.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Notice of proposed use of plenary powers in certain cases (A. (n.s.) 68

In accordance with a decision of the 13th International Congress of Zoology, 1948, public notice is hereby given of the possible use by the International Commission on Zoological Nomenclature of its plenary powers in connection with the following cases, full details of which will be found in *Bulletin of Zoological Nomenclature* Vol. 22, Part 1 to be published 5 April 1965.

(6) Designation of a type species for *Ornipholidotos* Bethune Baker, 1914 (Insecta, Lepidoptera). Z.N. (S.) 1663;

(10) Designation of type species for the following genera of Insecta, Lepidoptera:

Ypthima Hübner, 1818 (Z.N. (S.) 1672); *Napaea* Hübner [1819] (Z.N. (S.) 1673); *Iaspis* Kaye, 1904 (Z.N. (S.) 1674); *Pithcops* Horsfield [1828] (Z.N. (S.) 1675); *Arisoe* Hübner [1819](Z.N. (S.) 1676); *Phrissura* Butler, 1870 (Z.N. (S.) 1677); *Adopaeoides* Godman [1900] (Z.N. (S.) 1678); *Artines* Godman [1901] (Z.N. (S.) 1679); *Gegenes* Hübner [1819] (Z.N. (S.) 1680); *Halpe* Moore, 1878 (Z.N. (S.) 1681); *Papias* Godman [1900] (Z.N. (S.) 1682); *Phanis* Godman [1900] (Z.N. (S.) 1683); *Telicota* Moore [1881] (Z.N. (S.) 1684); *Zenis* Godman [1900] (Z.N. (S.) 1685).

Any zoologist who wishes to comment on any of the above cases should do so in writing, and in duplicate, as soon as possible, and in any case before 5 October 1965. Each comment should bear the reference number of the case in question. Comments received early enough will be published in the *Bulletin of Zoological Nomenclature.* Those received too late for publication will, if received before 5 October be brought to the attention of the Commission at the time of commencement of voting.

All communications on the above subject should be addressed as follows: The Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W.7, England.—W. E. China, *Assistant Secretary to the International Commission on Zoological Nomenclature.*

OBSERVATIONS ON *CALLOPHRYS MACFARLANDI* (LYCAENIDAE), IN THE SANDIA MOUNTAINS, NEW MEXICO

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There are some peculiarities, in the habits of *Callophrys* (*Sandia*) *macfarlandi* Ehrlich & Clench, which are worth noting.

Daily Activity of Adults. The butterflies crawl up from within the depths of the *Nolina* clumps (where they spend the night) between 8:00 and 9:00 A.M., if it is sunny. They then sun themselves, on the leaves of the *Nolina* clumps, before they begin to fly about. Even if there is a high wind, they will be up early, if the sun is shining. At the time these insects are on the wing in May and June windy mornings are frequent in the Sandia Mountains. If the wind continues all morning, they may never be observed on the wing, but can be discovered as they sit in the clumps. If alarmed under these conditions (early in the morning), the butterflies will sometimes simply drop and flutter deep down into the clump, where they can often escape capture. They stay close to the *Nolina* clumps most of the time, but occasionally alight in other nearby plants, such as scrub oaks. During the heat of a windless day, they are more active, and will be seen darting around the clumps, chasing each other, etc. After a warm day, they will remain active until dusk, definitely after sunset, while it is still light. Such behavior is rarely observed in butterflies. I have observed similar early evening activity in *Habrodias grunus* Bdv., as it flies around its food plant (*Quercus chrysolepis*) in the San Gabriel Mountains of southern California. It is exceptionally active just before dusk, after a hot summer day.

When I visited the type locality of *C. macfarlandi* and other nearby colonies, in late May and early June, 1960 and 1961, the population was at the peak of its flight period. (My original capture on 4 May 1958 represented an early specimen of the first brood.) It would be of interest to learn where the second brood, or later-emerging females oviposit, because by late June, the *Nolina* blossoms are gone, and the green seed capsules (which are also readily eaten by the larvae) are beginning to dry up. This leaves nothing suitable as food for larvae until the following spring, when new blossoms will shoot up within the clumps. Therefore, the question is, what becomes of the eggs of late females, and how do the resulting first instar larvae manage to locate suitable food? From rearing experiments which I carried out in 1959 and 1960, it is evident

that most of the pupae overwinter, and a few hatch the same season, in June. But, do the eggs of late females also overwinter?

On 15 June 1961, I collected a number of freshly emerged females, along with others in fair to poor condition. This was near the end of the period of emergence, and all the *Nolina* clumps had completely finished flowering. The green seed capsules were well formed by then, and some of them were beginning to dry out. From two seed stalks that were still green, I shook over 50 larvae, ranging in size from 3 mm long to last instar.

Larvae are easily brought through to pupation, on one or two stalks full of green seed capsules. The stalk can be kept in suitable condition for two weeks or more, by storing it in a plastic bag, and airing it often enough to retard mold. (Stalks with blossoms deteriorate much more rapidly, after being picked.) Larvae reared in this manner in June, 1959, formed pupae which were exposed to cold outdoor temperatures (in northeastern Kansas) for part of the winter. These pupae were then brought indoors, in February, 1960, and all emerged in good condition shortly thereafter. (This was, of course, not the normal time for emergence, but was caused by warmer temperatures, after a period of cold.)

One of the best locations for observing and collecting *C. macfarlandi*, and an easier one to reach than the type locality, is along Highway 66, east of Albuquerque, New Mexico, in the boulder-covered foothills of the Sandia Mountains, where scrub oaks and *Nolina* clumps are abundant. It is hoped that the type locality will be spared by collectors; it is possible that the Highway 66 location will eventually be engulfed, as Albuquerque expands eastward toward Tijeras Canyon.

The food plant of *Callophrys macfarlandi* may not be *Nolina microcarpa* S. Wats.; typical *N. microcarpa* has a flowering stalk which extends well above the clump itself. It is a common and widespread species from central to southeastern Arizona, and from central to southern New Mexico. *N. microcarpa* is described by Benson and Darrow (1954), pp. 72–74, and is illustrated by photographs on Plate XII (E, G). The *Nolina* growing in the type locality of *C. macfarlandi* has a flowering stalk which rarely extends above the clump of leaves. Of course, this feature could vary from one locality to another. I have no specimens of this plant, so am not able to check it for other morphological differences, if such exist.

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MORE OBSERVATIONS ON THE ATTRACTION OF DIURNAL LEPIDOPTERA TO LIGHT

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The phenomenon of butterflies being attracted to lights seems to be of keen interest to lepidopterists. Observations are often recorded and the specimens given an honored place in the captor's collection. With the recent advent of ultraviolet light as a popular medium for moth collecting, records of butterflies attracted to lights have greatly increased. It is quite apparent that ultraviolet light attracts and holds butterflies to a much higher degree than incandescent light. During five years of collecting with a standard 20-watt ultraviolet light and moth sheet I have taken 50 butterflies. In the last 16 years I have found only four butterflies attracted to other light sources.

Undoubtedly a large precentage of the specimens collected at light are startled from their resting places in nearby trees or bushes by the collector or some of the larger insects attracted to the light. There is some evidence that occasional specimens are drawn from a considerable distance. For example, on the evening of August 16, 1964 I was collecting moths in a state wildlife area near Moberly, Missouri. The moth sheet was hung on a tree facing a large open field. I was standing about 50 feet in front and to the side of the sheet watching for sphingids and *Catocala* which frequently fly in and settle on the ground as much as 30 or 40 feet from the sheet. I observed what appeared to be a *Catocala* coming in a skipping zigzag flight toward the sheet. Instead of dropping to the ground it flew directly to the sheet and settled near the light. To my surprise I found it was a worn *Cercyonis pegala* (Fabricius). When first observed it was about 80 to 90 feet from the sheet. The field was recently plowed with only a trace of fresh growth. About 200 feet further were brushy areas which would seem to be the logical source of the butterfly. Perhaps it was startled from its resting place by some wan-

dering creature of the night and then drawn by the compelling glow of the light or perhaps the light itself was the stimulus which drew it from its retreat. Butterflies attracted to ultraviolet light are usually comparatively unwary and easily collected with the killing jar.

The following records include every major family of the area with the exception of the Papilionidae. There is no apparent reason for this absence as we have six species of *Papilio* present and in many cases they are abundant diurnal insects. In the following list condition of the specimens is indicated by (F) fresh, (W) worn, or (B) battered.

Species taken at incandescent light sources:

Erynnis horatius (Scud. & Burg.) 1♀ (F) 3 Sept. 64, Fort Scott, Arkansas.
Pieris protodice Bdv. & LeC. 1♂ (F) 9 June 58, Sugar Creek, Missouri.
Strymon cecrops (Fabricius) 1♀ (B) 3 Sept. 61, Rogers, Arkansas.
Asterocampa celtis (Bdv. & LeC.) 1♂ (F) 14 Aug. 48, Independence, Missouri.

Species taken at ultraviolet light:

Amblyscirtes nysa Edwards 1♀ (F) 28 Aug. 64, Independence, Missouri.
Atalopedes campestris (Boisduval) 1♀ (W) 1 Aug. 60, 1♀ (W) 21 Aug. 60, 1♀ (B) 23 Aug. 60, 1♀ (F) 24 Aug. 61, 1♂ (B) 26 Aug. 61, 1♂ (F) 3 Aug. 62, 1♂ (W) 6 Oct. 62, 1♀ (F) 31 July 63, 2♀ (F) 2 Aug. 63, 1♂ (B) 2 Aug. 63, 1♀ (F) 3 Aug. 63, Independence, Missouri.
Euphyes vestris (Boisduval) 1♂ (B) 27 June 60, Warsaw, Missouri.
Polites themistocles (Latreille) 1♀ (W) 17 Aug. 62, Independence, Missouri; 1♀ (W) 1 Aug. 64, Moberly, Missouri.
Thorybes bathyllus (Smith) 1♂ (F) 16 Aug. 64, 2♀ (F) 16 Aug. 64, 1♀ (B) 16 Aug. 64, Moberly, Missouri.
Thorybes pylades (Scudder) 1♀ (B) 28 June 64, Warsaw, Missouri.
Epargyreus clarus (Cramer) 1♂ (B) 31 Aug. 61, Independence, Missouri.
Strymon cecrops (Fabricius) 1♀ (F) 9 July 62, Warsaw, Missouri.
Strymon melinus Hübner 1♀ (F) 14 Oct. 61, Independence, Missouri; 1♀ (F) 26 July 64, Warsaw, Missouri; 1♂ (F) 16 Aug. 64, Moberly, Missouri.
Everes comyntas (Godart) 1♂ (W) 9 May 60, Independence, Missouri.
Asterocampa celtis (Bdv. & LeC.) 1♀ (F) 16 Aug. 60, 1♂ (B) 26 Aug. 60, Independence, Missouri; 1♂ (F) 1 Sept. 60, Rogers, Arkansas; 1♂ (F) 6 Aug. 62, 1♂ (F) 4 Sept. 62, Warsaw, Missouri.
Asterocampa clyton (Bdv. & LeC.) 1♂ (B) 31 Aug. 60, 1♀ (F) 3 Sept. 60, Independence, Missouri.
Vanessa atalanta (Linn.) 1♂ (W) 5 Aug. 61, 1♂ (W) 9 June 62, 1♂ (W) 2 June 63, Independence, Missouri; 1♀ (F) 10 May 64, Warsaw, Missouri.
Vanessa cardui (Linn.) 1♀ (F) 27 July 60, Independence, Missouri.
Polygonia interrogationis (Fabricius) 1♀ (F) 25 May 62, 1♂ (W) 3 Aug. 63, Independence, Missouri.
Polygonia comma (Harris) 1♀ (W) 20 July 62, 1♂ (F) 30 July 62, Independence, Missouri.
Phyciodes tharos (Drury) 1♂ (W) 17 July 60, Independence, Missouri.
Danaus plexippus (Linn.) 1♂ (W) 21 March 62, Cd. Victoria, Mexico; 1♀ (F) 18 Aug. 62, Birmingham, Missouri.
Lethe portlandia (Fabricius) 1♂ (W) 18 Aug. 62, 1♂ (W) 23 Aug. 63, Birmingham, Missouri.
Cercyonis pegala (Fabricius) 1♂ (F) 28 June 64, 1♂ (W) 16 Aug. 64, Moberly, Missouri.

BUTTERFLIES ON KENT ISLAND, NEW BRUNSWICK

ROBERT E. GOBEIL[1]
Cole Road, Biddeford, Maine

During the summer of 1964 (June 29 to September 4), while engaged in research studies on birds, the author took notes on butterflies observed on Kent Island. This 200-acre island, site of the Bowdoin Scientific Station, is the largest of three islands, located about six miles southeast of Seal Cove, Grand Manan, New Brunswick, Canada. The northern and western parts of Kent Island are characteristic Canadian Zone Forest, with balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*) the most common species of trees. American mountain-ash (*Sorbus americana*) and birch (*Betula*) are also present as smaller trees (Gleason, 1937). The central part of the island is mainly open fields of grasses such as timothy grass (*Phleum pratense*), red-top (*Agrostis alba*), brown bent grass (*Agrostis borealis*), and blue-joint grass (*Calamagrostis canadensis*) (Potter, 1937). Most butterflies were observed in the open fields or along pathways in the woods; very few were actually seen in the densely wooded sections of the island.

The butterfly fauna of Kent Island differs from nearby mainland faunas in that relatively few species are present. Over 95 species of butterflies have been recorded in nearby Maine (Brower and Payne, 1956) but on Kent Island, during the summer of 1964, only 11 species were recorded; not a single skipper was either seen or collected. The remoteness of the island, situated as it is at the mouth of the Bay of Fundy, probably limits the number of species found on the island. Even though few species are present, at certain times of the summer, especially when Canada thistles (*Cirsium arvense*) bloom, fair concentrations of butterflies may be seen. Collecting was carried out on only one day (August 28, 1964); it is very probable that more species would be recorded if intensive collecting were carried out on the island.

Many more butterflies were seen in August than in July; the contrast between weather conditions of July and August may have been a contributing factor. In July, the only days free of *dense* fog were 17, 20, 23, 24, 25, 26, 30, and 31; in August there was little fog except for a spell of three or four days at the end of the month.

The following list consists of all butterflies seen or collected during the summer of 1964; dates and other pertinent data are also included.

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[1] Contribution No. 30 of the Bowdoin Scientific Station, Kent Island, Grand Manan, New Brunswick, Canada.

Most species found on Kent have also been recorded in southern Maine (Gobeil, 1962) and all 11 species have been recorded in Maine (Brower and Payne, 1956). The names of the butterflies follow the dos Passos list, while those of the plants follow Gray's *Manual of Botany* (eighth edition).

I wish to thank Dr. A. E. Brower and Dr. Charles E. Huntington for reviewing the manuscript and offering helpful advice and criticism.

Papilio polyxenes asterius Stoll

One seen near the edge of the woods on July 3.

Colias eurytheme Boisduval

One observed on July 15.

Colias philodice Godart

Seen regularly from July 30 (1) until September 4; two were collected on August 28.

Pieris rapae (Linnaeus)

Five sightings July 5 to August 20; all were for single individuals.

Danaus plexippus (Linnaeus)

The monarch was very common, especially in late summer. First observed on July 22 (2); from this date on, three or four seen regularly on most sunny days. Two caught in mist nets used for banding birds on July 30. On August 28, at least 15 were counted in a small patch of Canada (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) in an open field; three were collected.

Nymphalis antiopa (Linnaeus)

Only two sightings of the mourning cloak: one on July 15 and one seen flying along the western shore of the island on August 1.

Vanessa atalanta (Linnaeus)

The red admiral is probably the most numerous species on the island during the summer, having been seen almost daily in just about all parts of the island. Eight were counted in an open field in the northern part of the island on August 28, when one was also collected.

Vanessa virginiensis (Drury)

A very common species, especially in August. First seen July 28 and then on most sunny days throughout August; on August 28 over 35 counted in a thistle patch, where four were collected.

Limenitis arthemis (Drury)

One seen in an open field on August 3.

Limenitis archippus (Cramer)

Only two sightings of single individuals: July 15 and July 30.

Lycaena phlaeus americana Harris

A species which appears to be more common in the early part of the summer. Observed throughout July in small numbers, the last sighting on August 3 (1).

Literature Cited

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Gobeil, R. E., 1962. Partial list of butterflies found in the Biddeford Region. Maine Field Naturalist, 18: 147.

Potter, D., 1937. Plants Found Growing on Kent's Island 1935–36. Bulletin No. 3, The Bowdoin Scientific Station: 19–26.

LEPIDOPTERA ACTIVE IN LATE DECEMBER IN PENNSYLVANIA

During Christmas week, 1964, a tropical air mass worked northward up the Atlantic coast, penetrating the Philadelphia area on Christmas Eve after two days of rain, fog, and temperatures in the high forties. As had happened farther south, temperature records toppled in the wake of the warm front. The mercury climbed steadily the night of the 24th and, under mostly sunny skies, a 93-year record high of 68° F. was registered on Christmas day. This unseasonable weather brought out a male *Nymphalis antiopa* (L.) (Nymphalidae) which the writer captured along Wissahickon Creek, amid equally unprecedented dandelion, moss pink, chickweed, and *Senecio* blossoms.

The following day was cloudy with temperatures again at record levels, including an official high of 68° at the Weather Bureau, and an unofficial 71° at the writer's home. Although no butterflies were seen, a male *Eupsilia sidus* Gn. (Noctuidae) came to light in the garden with a temperature of 62° F. at 9:30 P.M. Dec. 26. *E. sidus* is a well-known hibernator and is usually the first species to fly in the spring; my earliest record is March 10.

Three pupae of *Colias eurytheme* Bdv. which were outdoors in a ventilated container showed traces of orange pigment when examined on Dec. 26. Brought indoors, all three eclosed as males on Dec. 28. Nineteen other pupae in the same lot did not show signs of development and

were allowed to remain outdoors. It would seem that, given a few more days of springlike weather, even species which overwinter in the pupa might have become active.

As a postscript, the freak warm spell came to an end with the passage of a northeast storm and attendant cold front, December 27.

ARTHUR M. SHAPIRO, *7636 Thouron Ave., Philadelphia, Pa.*

THE FLIGHT PERIOD OF *BOLORIA EUNOMIA*

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Observations recently published in this *Journal* by Neilsen (1964, 18: 233–237) remind me of a curiosity which, strangely, seems to have escaped formal notice in any mentions I have seen. The abbreviated flight period of *Boloria eunomia* (Esper) is something collectors should know about and reckon with when exploring for this species; probably it is the short adult life span full as much as the intense localization which slows discoveries.

Mr. Neilsen noted specimens alighting to dry their freshly hatched wings. This had a significance which he may appreciate better in future years after he learns just how lucky he was in his described mid-June bog forays in Michigan. Two or three days later or earlier he might well have collected in the same places with never a sight of this fine bolorian.

Mr. Henry Hensel, of Edmundston, New Brunswick, really should be writing this note, rather than me, since it is his fieldwork which provides definitive knowledge of this aspect of *eunomia*. On reflection, it will appear that most of the previous captures of "*dawsoni*" (the form occurring along the Eastern U. S.–Canadian border region) have been of the one-shot, visit sort. Whereas in adjacent Temiscouata County, Quebec, a few miles from Hensel's home, there are magnificent bogs which have provided him with a rare opportunity: perhaps he is the only person who has observed this subspecies in thriving colonies over a period of years.

The ecology and behavior of species are difficult to learn from tabulations. Mr. Neilsen's accounts are unusually graphic, a model of description made vivid by the personal touch. I shall attempt to make my point in the same manner, by narration from experience, viz.:

On my first visit to Hensel's bog he warned me that it was essential to be there on "the day," so to speak, but when he reported *eunomia*

just beginning emergence early in the week I arrived on the weekend confident that I would take at least a few samples, if perhaps somewhat worn. The day was fine; we were on breeding grounds where Hensel, four days earlier, had taken 40 or so immaculately fresh specimens. The best we could do was to net one feebly fluttering male battered almost beyond recognition.

On the next occasion, forewarned but still in unconscious protest that such things should be, I timed my visit to get there on the day he thought they might be due to emerge. We encountered a morning emergence of males and were able to make a large collection. The salient thing is that Hensel had checked the place two days earlier and reported none in evidence; also, in our combined huge series only about two percent were females and those were mostly taken freshly hatching in the afternoon. So, then I was forced to give credence to Hensel's remarks to the effect that the flight of males would be gone in a day or two and that the time for females was "tomorrow." It was easy to see that the males might literally "fly themselves to death" on their endless patrolling but not so easy to adjust to the idea that this butterfly is indeed one with the mayflies, here today, gone tomorrow. Hensel told me all this, but the implication didn't sink home until I had the chance to be a party and witness.

When one considers the large fluctuations in earliness and lateness of seasons in the northern bogs; allowing generously for cold and rainy spells at the critical dates (*B. eunomia* being a species which flies in sunshine and is not in evidence when the day is cloudy) it is easy to see that the finding of new colonies of *eunomia* is a matter of luck and chance over and above the hazards for which one normally might allow. For example, the flight may occur over the whole range between, say, June 8 and June 30, dependent on place, exposure, season, and weather. Then, say that for a given place and year perhaps June 14–18 are the only days when one might be rewarded with sight of even a battered individual to encourage further exploration. Then, maybe a collector does get there on "the day," but it is cool and somewhat cloudy and these butterflies aren't moving. These are the odds against collectors.

It then seems probable, as Mr. Neilsen suspects, that *eunomia* is resident in many bogs along the Canadian boundary region. It is even a distinct possibility that *eunomia* occurs in areas where collectors have searched in vain for it. The unwelcome moral of Hensel's extensive experience with this butterfly, over the years, is that collectors who go exploring for it had better plan to do their visiting on the proper day of the week!

SPEYERIA CALLIPPE AND *ARTEMISIA*, A POSSIBLE FOODPLANT

It is generally supposed that all *Speyeria* feed, as larvae, on some species of *Viola* and this assumption is supported by all species for which the life history is known. The author was thus startled to find *Speyeria callippe gallatini* McDunnough ovipositing on a woody *Artemisia* (sagebrush) probably *A. trifida*, and to find this butterfly consistently associated with sagebrush. At 11 localities in Broadwater, Madison, and Carbon counties, Montana; Park, Bighorn, and Lincoln counties, Wyoming; and Uintah County, Utah, where *S. callippe* was present in numbers, sagebrush was in all cases present within 100 feet of captures. These habitats range from a semiarid wash some tens of miles from the nearest forest, at 4,300 feet six miles northwest of Three Forks in Broadwater County, Montana (June 28, 1964), through montane park sage openings (the majority of localities) to tree line at 9,800 feet on Clay Butte west of Beartooth Butte in Park County, Wyoming (July 21, 1964). On the cliffs three miles north of Fossil, Lincoln County, Wyoming (August 2, 1964) where *S. callippe* was particularly abundant, several individuals were flushed from within *Artemisia* bushes where they had been crawling along the woody trunk and branches. A female was followed, observed to oviposit on the loose bark near the base of the trunk, allowed to crawl out of the bush, fly to another plant 10 feet distant, and repeat the process at which point she was captured. It might be postulated that *S. callippe* oviposits on branches aboveground, avoiding exposure of the possibly overwintering egg to ground moisture. The newly hatched larvae would then have to search for violets in the spring. No evidence of violet plants or fruits was found at Fossil in spite of a careful search.

Of great interest was the discovery of unidentified *Speyeria* larvae of several instars, resting in the upper branches and green shoots of sagebrush at Buffalo Creek, 25 miles east of Sheridan in Sheridan County, Wyoming (June 17, 1964). A search of the ground flora produced no *Viola* so it must be assumed in this case that violets are not the foodplant of at least one species of *Speyeria*. The presence of larvae perhaps otherwise unassociated with sagebrush in the upper branches of shrubs could be attributed to response to peculiar weather conditions preceding a storm in dry country where sheetwash is a danger to organisms near the soil. The larvae were observed at about 5:00 P.M. in a light rain which developed later into an all-night rainstorm depositing two inches of water and accompanied by flooding. It is the author's opinion that these normally nocturnal feeding larvae had moved into their feeding territory

under the abnormally overcast and humid conditions, but had not commenced to feed.

Taking all points into consideration; the oviposition of *S. callippe* on sagebrush; the occurrence of *Speyeria* larvae on sagebrush, and the presence of sagebrush at all the author's collecting sites for *S. callippe* it is suggested that sagebrush may serve as the larval foodplant. Specimens of the larvae and adults have been deposited in the Yale Peabody Museum.

Christopher J. Durden, *Dept. of Biology, Yale University, New Haven, Conn.*

A METHOD FOR OVERWINTERING HIBERNATING LARVAE OF BUTTERFLIES

F. Martin Brown
Fountain Valley School, Colorado Springs, Colorado

In a recent issue of the *Journal* (18: 201–210, 1964) Noel McFarland presented many useful tips for preserving the immature stages of lepidoptera. His statement that overwintering larvae are easily handled by storage in jars in shaded areas but subject to normal out-of-doors temperatures is true in part. There are some areas in the country where this can be done without too great loss of specimens. I have found here in Colorado, and W. H. Edwards discovered almost a century ago in West Virginia, that overwintering losses under such conditions are very high.

Edwards's solution was to send his larvae for overwintering to an icehouse and to have the boxes in which he stored the larvae packed in the cold, moist sawdust used to retard the melting of the ice. Alas, there are no longer such places.

The environment of our modern electric or gas refrigerators, household or laboratory, is much too dehydrating to be of use. I have had success with a simple and inexpensive device that I have passed on in letters to some friends. I repeat it here for a larger audience. I use a portable, or automobile, ice chest, the sort that has come into vogue for picnics or camping trips. These can be purchased in many places for less than $20. I recommend one that is sturdily built. It will last for years. Mine has a good latch on it that seals the lid effectively against too much loss of moisture or ingress of heat. It is metal and plastic construction with a drain hole and a place for racks.

When larvae begin to go into hibernation, often in late July and August for some species of butterflies, I put each into a sterile shell vial and

loosely plug it with sterile absorbent cotton. A data slip is placed in the vial with the larva. The vials are laid in the plastic racks of the icebox. The icebox then is charged with a dozen or so large ice cubes and a 10-pound plastic bag of such cubes that is sealed against leakage. I insert through the drain hole a thermometer in a cork. By the middle of September I find that there is little reason to open the chest for insertion of new material. From then on I watch the thermometer. When the temperature in the chest reaches 36–38° F. I open it and replace the melted bag of ice and if there is no free water in the chest I add a few loose cubes.

I have found that when Satyridae are being carried in the chest I can remove them after they have been in hibernation for 11 or 12 weeks and break hibernation by allowing the larvae to warm up in their shell vials to room temperature. Several weeks before this it is wise to bring in a piece of sod, potted in a low, large flowerpot. Warmth, moisture, and sunlight will produce an abundant supply of food for most Satyridae and the grass-feeding Skippers.

My technique differs from McFarland's in that I keep my larvae isolated. Incidently, this does not work well with the larvae of some Nymphalidae that are gregarious in the early instars. They appear to need "company" to thrive. Each larva in its individual vial is examined each day. Fresh spears of grass are put into sterile vials and the larva transferred when the food is limp or used up. This greatly reduces loss from mold and disease. It also allows precise records to be kept, something that is difficult with "bulk" feeding. I preserve the shed head capsule and skin of each instar when I am making a careful study of a species.

I do not disturb larvae that are about to molt. Before molting and before hibernation the larva clears its gut of frass. If after this the larva is inactive for four or five days I put it into the hibernator. If on the other hand the larva is active after molt I transfer it to fresh food and collect the exuvia. Head capsules I mount on a bit of card and put that and a label on a pin.

The shed skin can be moistened and extended and then mounted as a slide for study of the hairs, etc.

The advantage of the ice chest is that the environment is constant in humidity and the temperature easily controlled to prevent too early breaking of hibernation. This happened for me with three successive outdoor winterings. Another, perhaps greater, advantage is that the hibernating larvae are where they are handiest, in the laboratory or at home.

COLLECTING SPHINGIDS AND OTHER MOTHS ON THE MISSISSIPPI GULF COAST

ROBERT TAYLOR AND BARBARA TAYLOR
Bellevue, Nebraska, U. S. A.

We were residents of Biloxi, Harrison County, Mississippi from January through September, 1964. During this period we operated a black light at Biloxi and did other collecting, primarily in southern Mississippi. Approximately 60% of the material we collected was taken at Biloxi. Many of the specimens were furnished to Bryant and Katharine Mather of Jackson, Mississippi for study and to yield data for the survey of Mississippi Lepidoptera being conducted by them. References to previous records for Mississippi moths given below are taken from their unpublished records. Our primary interest is in Sphingidae. In this family we took 430 specimens representing the following 24 species (40 species are known from the state):

Herse cingulata Fabr. (46), *Phlegethontius sexta* Joh. (58), *Phlegethontius quinquemaculata* Haw. (15), *Phlegethontius rustica* Fabr. (16), *Chlaenogramma jasminearum* Guer. (4), *Dolba hylaeus prini* Smith (5), *Ceratomia undulosa* Walk. (7), *Ceratomia catalpae* Bdv. (48), *Atreides plebia* Fabr. (15), *Sphinx kalmiae* Smith (2), *Lapara halicarniae* Stkr. (31), *Smerinthus geminatus* Say (4), *Paonias excaecata* Smith (1), *Paonias myops* Smith (12), *Paonias astylus* Dru. (4), *Cressonia juglandis* Smith (1), *Epistor lugubris* Linn. (1), *Hemaris diffinis* Bdv. (1), *Pholus satellitia pandorus* Hbn. (6), *Pholus fasciatus* Sulz. (9), *Ampeloeca myron* Cram. (31), *Darapsa pholus* Cram. (23), *Xylophanes tersa* Linn. (86), and *Celerio lineata* Fabr. (4).

The two *S. kalmiae* were males taken August 9 at Brooklyn, Forrest County and August 15 at Carnes, Forrest County. This species is not known to have been taken previously in Mississippi. *Chlaenogramma jasminearum* and *Paonias astylus* are not known to have previously been taken in southern Mississippi and were each previously known from Mississippi by a single specimen taken respectively in 1921 at State College and in 1960 at Jackson.

In other families a few records that seem to be worthy of note are: *Citheronia sepulchralis* G. & R. previously known from Mississippi by a single specimen taken at Canton in 1963; and the following, none of which are known to have previously been taken in Mississippi: *Panthea furcilla centralis* McD., Biloxi, April 15; *Acronicta brumosa* Gn. Biloxi, April–May (7); *Euherrichia monetifera* Gn., Biloxi, April (2 males);

Eutelia pulcherrima Grt., Hattiesburg, May; *Doryodes spadaria* Gn., Biloxi, April; *Drasteria graphica* Hbn., Biloxi, March–April (4); *Schizura apicalis* G. & R., Biloxi, April; *Cleora manitoba* Grossbeck, Biloxi, April (4); *Pseudoboarmia buchholzaria* Lemmon, Biloxi, April; *Glena cognataria* Hbn., Biloxi, April; and *Limacodes rectilinea* G. & R., Hattiesburg, May. The species listed above as previously unrecorded from Mississippi were determined by Dr. F. H. Rindge, American Museum of Natural History, New York.

Collecting on the Mississippi Gulf Coast ranged from excellent to disappointing. The specimens of *S. kalmiae* were taken on poles supporting mercury-vapor lights. Such poles were frequently very productive and on some nights 20–35 specimens of Sphingidae were taken on a single pole.

Our appreciation of the significance of much of what we collected was contributed to greatly by having made the acquaintance of active local collectors. We suggest that others, like ourselves, who may reside temporarily in an area due to military service commitments (or for other reasons) and who collect during such time contact local collectors, both for the visitor's benefit and so that their data may be properly included in the appropriate regional compilations.

Appreciation is expressed to Bryant and Katharine Mather who helped make our collecting in Mississippi so worthwhile and for their assistance in the preparation of this short article.

ERNEST LAYTON BELL (1876–1964)[1]

Ernest L. Bell was born November 21, 1876 in Flushing, Long Island, New York, and lived his entire life of 89 years in that town. As a young man he obtained a position with the First National Bank (now the National City Bank), eventually becoming head of the loan department prior to his retirement after World War II.

From early manhood Ernest Bell had a propensity for collecting, first local Indian lore, then stamps and coins. Coin collecting was his prevailing hobby up to the time of his death. Primarily, however, he was an outdoor man with a bent for studying living things. Before turning his attention to entomology, he collected herpetological specimens extensively. His main interest turned to Lepidoptera, primarily butterflies, in 1919. He ultimately decided to specialize on the Hesperioidea.

[1] This obituary is abstracted from a manuscript scheduled for publication in the *Journal of the New York Entomological Society* and kindly made available by the authors.—EDITOR

Although an amateur, Ernest Bell was an exceptionally gifted taxonomist, and eventually became one of the foremost authorities on New World hesperiids. During his studies he described a number of new genera and a total of over 200 species and subspecies of skippers, very few of which have fallen into synonymy. For many years he cooperated with eminent workers in the field, such as A. W. Lindsey, R. C. Williams, W. P. Comstock, K. S. Hayward, and W. H. Evans, often co-authoring papers with some of them. During Evans' preparation of his four-volume "Catalogue of American Hesperiidae," Bell was frequently consulted, and after publication of the work made notes of errors in connection with arranging the American Museum collection. These notes resulted in an "Addenda and corrigenda" published in 1951–1955, in which Evans gives Bell credit for most of the corrections which were included.

Ernest Bell was president of the New York Entomological Society in 1933, and in the following year was appointed Research Associate by the American Museum of Natural History, a title which he held until the time of his death. His extensive collections of hesperiids and other insects were donated to the American Museum. He was a charter member of The Lepidopterists' Society, although he did not publish in the *Journal.* His bibliography on Nearctic and Neotropical Hesperiidae runs to about 60 titles, spanning the years 1920 to 1959, primarily in the *Journal of the New York Entomological Society* and *American Museum Novitates.*

Ernest Bell married Mina A. Morrell in 1899, a marriage which lasted until her death in 1952. The Bells made many trips, across the United States, to the Caribbean islands, particularly Jamaica, and to Central America, for the purpose of collecting hesperiids. They also enjoyed vacationing in New England, and for many years a summer month was spent in rural Vermont or New Hampshire.

In 1934 Bell accompanied David Rockefeller and the late Frank E. Lutz on an extensive collecting trip to the Grand Canyon and adjacent territory. As a result, many new hesperiids were added to the known fauna of the southwestern United States.

Ernest Bell was a self-made naturalist, collector, sportsman, lepidopterist, and a grand person to have known. To entomologists in this country and abroad his passing leaves a void; it will be regretted by all his friends, acquaintances, and correspondents.—HERBERT RUCKES, *Flushing, New York* and CYRIL F. DOS PASSOS, *Mendam, New Jersey.*

ADDENDA ET CORRIGENDA

to the "Synonymic List of Nearctic Rhopalocera."

Page 3 25½ add *hacebolus* (Scudder), 1872

Page 10 *Polites* 98—Transpose *siris* Edwards, 1881 and *sonora* Scudder 1872. The specific name is *sonora* and *s. siris* is a subspecies.

Page 19 162—add *oilus* MacNeill, 1962 (*lapsus calami*)

Page 20 *Erynnis* 170—*pacuvius* Lintner should be listed also as a subspecies and preceded by an a. The other subspecies become b, c, and d.

Page 21 175½ *tibullus* (Scudder & Burgess) is a synonym of *propertius* (Scudder & Burgess) and not of *telemachus* Burns.

Page 35 256b—add *luxuriosus* Forbes, 1960 (Reiff MS)

Page 36 262 *glaucus* Linnaeus, 1758 instead of 1764
a. *g. glaucus* Linnaeus 1758 instead of 1764

Page 39 278 *napi* (Linnaeus), 1758 instead of 1761

Page 43 *vividior* Berger, 1945, should be added to 291 as b and the present "b" changed to c.

Page 44 *Zerene eurydice ab. nigrocapitata* Riddell, 1941
Zerene eurydice f. marginata Riddell, 1941
Zerene eurydice ab. flavolineata Riddell, 1941
Zerene eurydice f. rubrosuffusa Riddell, 1941. These four names should be added to 298 chronologically under forms and aberrations.

Page 51 line after *Emesis* Fabricius, 1807 add (Opinion 232, name 660)

Page 70 486 *aidea* author's name and date should read (Guérin-Meneville) "1829–44" [1844]. Also the author's name should be corrected in the index p. 107.

Page 78 Add asterisk before 532. Next line—delete line a. Next, third line change b to a.

Page 98 Correct spelling of Latreille in three places: Lines 5, 7, and 8
Danaida Latreille
Danais Latreille
Danaus Latreille

Page 101 649 *mixturata* and *kodiak* should be transposed and the subspecies preceded by k. instead of m.

Page 105 *678—*sofia,* Strecker 1881 should read 1880.

NOTICE TO CONTRIBUTORS TO THE *JOURNAL*

Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11″ paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal*. Legends of figures and tables should be submitted on separate sheets.

Reprints may be ordered, and at least 25 gratis separates (including any other material published on these pages) will be provided, if requested at the time galley proof is received.

Address correspondence relating to the *Journal* to: Dr. J. A. POWELL, 112 Agriculture Hall, University of California, Berkeley, Calif., U. S. A.

Material not intended for permanent record, such as notices, current events, anecdotal field experiences, poems, philatelic Lepidoptera, etc. should be sent to the *News* Editor: E. J. NEWCOMER, 1509 Summitview, Yakima, Wash., U. S. A.

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(Complete contents on back cover)

20 December 1965

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

Active Members—annnal dues $6.00 (U. S. A.)
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Dues may be paid in Europe to our official agent: E. W. Classey, 353 Hanworth Road, Hampton, Middx., England.

In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is Yale University, Peabody Museum, New Haven, Connecticut. Second class postage paid at Lawrence, Kansas, U.S.A.

JOURNAL OF
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PRESIDENTIAL ADDRESS TO THE TWELFTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

Presented at San Diego, June 20, 1965

THE IMPORTANCE OF COLLECTING—NOW

FREDERICK H. RINDGE
The American Museum of Natural History, New York, N. Y.

During the past few years there has been more and more concern about the forthcoming "population explosion"; the current estimate is that the world's population will double its present figure before the end of this century, just a short 35 years from now. This means that there will be a daily increase of 160,000 people, or 110 babies every minute—the equivalent of 10 football teams. If no steps are taken to slow down this avalanche of humans, by the year 2050 there will be only one square yard of dry land per person on the earth. You may hope that these figures may apply only to Asia, Africa, or Latin America—that they can't apply to this country. This is just wishful thinking on your part.

How will this tremendous expansion effect the land upon which we live? Much more food will be needed to feed these hordes; this means more land under cultivation. Some of this will have to be carved out of forests. Many forests throughout the world are being ruthlessly destroyed for their raw materials. The results—loss of the protection of watersheds, the prevention of floods and erosion—can be seen in countries such as Greece, Yugoslavia, Jordan, Syria, and Chile, where the land is completely deforested and eroded down to bare rock. Some marginal land is used for grazing by cattle and sheep; unless care is taken to prevent overgrazing, these areas will turn into worthless semideserts.

With increased agricultural uses, there is a much greater use of pesticides and herbicides—and their effects, unfortunately, are not always restricted to the fields for which they are intended.

You all know from experience how many more automobiles there are today than there were just a few years ago, and are acquainted with some of the problems arising therefrom. Smog, plus many more industrial plants, are producing a steady increase in the carbon dioxide content of the air. This produces a heat blanketing effect, which is gradually raising the earth's mean temperature. Consequently this may cause a gradual melting of the polar ice caps, raising the levels of the oceans, thus flooding the low-lying coastal areas of all the continents. This is another factor that will reduce the amount of dry land.

Increased housing will be needed to shelter all the people, which takes still more land. By the end of this century there will be a solid procession of cities and suburbs from Boston to Washington; much of southern California is rapidly approaching this condition. In fact, in the United States alone one million acres per year are gobbled up by urban sprawl, roads, industry, and the like.

All of the above factors are having their effects on the land—undisturbed habitats for collecting are rapidly getting fewer and farther between. This is happening throughout the country, as a glance at the last seasonal summary in the *News of the Lepidopterists' Society* will reveal. Some of the expressions from that publication are as follows: "urban sprawl continues to encroach on collecting areas; the native flora is rapidly being deleted; too much crop spraying; the area where the largest colonies are located will soon be destroyed due to the construction of a new super highway; the recently discovered habitat has been wiped out by a recreation center." I'm sure you will have had experiences along these lines.

Obviously this trend is going to continue, and it will be accelerated. It is, therefore, of vital importance to do as much intensive collecting and life history work in as many places as possible, and to start as soon as possible. Only in this way will future generations of entomologists have access to actual material and knowledge of the species which occurred during the last half of the twentieth century. As you know, several butterfly populations have already been wiped out here in California as well as elsewhere, and others are in grave danger of undergoing a similar fate. Because we cannot halt the spread of "civilization" we should collect adequate series of as many species of butterflies and moths as possible while they are still in existence.

To make a collection of lasting value, all specimens should be correctly mounted and labeled before being added to the collection. It is of great importance that really complete locality data be given on each label. By next year your favorite collecting area may no longer exist as such—

specimens from such localities will become more valuable as time goes on, as they will indicate to later generations of lepidopterists where the species once occurred, and what the members of the population looked like. Those of us who are doing taxonomic studies now are thankful for the old collections that have been preserved, as these specimens are of great help to us—unfortunately, they are usually much fewer in number than we would like to have. To ensure that as many specimens as possible are preserved for posterity, it should be the aim of everyone who has a collection to make certain that it is deposited in a museum that has an active section devoted to the Lepidoptera. There are several modern, forward-looking institutions in this country that would be glad to receive such collections, whether the latter are small or large. Only in this way will our children and grandchildren be able to study what we, here today, are fortunate enough to preserve for them.

Because of the above reasons I would urge you most emphatically to collect extensively in all available natural habitats. Also, you should encourage and assist young people to collect so that they, too, will have the satisfaction of contributing knowledge and material in an area which may become lost.

FIRST CONNECTICUT RECORDS OF *THYMELICUS LINEOLA*, AN INTRODUCED HESPERIID

Robert L. Apter and John M. Burns
619 Main St., Portland, Conn., and Dept. of Biology, Wesleyan Univ., Middletown, Conn.

Thymelicus lineola (Ochsenheimer), a Palearctic hesperiine skipper, made its Nearctic debut at London, Ontario, Canada, in 1910. So far as known, it now occupies much of southeastern Ontario, plus closely adjacent parts of the United States (i.e., the Detroit area, the Buffalo area), and, in the United States, occurs also at a few scattered points, most of which lie in the Piedmont of the Northeast. No New England localities have thus far been reported for this species.

We have found *T. lineola* in small numbers at two places in central Connecticut. The ten Connecticut specimens now at hand are superficially and genitalically similar to specimens from other populations in eastern North America. We obtained our limited material as described below.

In a hayfield at the junction of Cox Road and Penfield Hill Road,

Portland, Middlesex County, Apter caught two examples of *T. lineola* in the course of general butterfly collecting on June 25, 1963. When subsequently spreading them, he damaged one so badly that he discarded it, not realizing what it was; but he successfully spread the other, a male, and correctly identified it. In early July, Apter contacted Burns regarding this specimen; and we made three fruitless attempts to secure additional material at Portland in 1963.

In 1964, we checked the Portland locality for *T. lineola* on June 11, 18, 23, 25, and 26, and July 7 and 16. On only three days did we find any individuals of this species: on June 23, each of us caught one male; on June 25, Apter collected one male and Burns, three; and on June 26, Apter got one male.

In roadside grass and weeds at precisely the junction of a single-track line of the New York, New Haven, and Hartford Railroad with State Route 159, on the east bank of the Coginchaug River, Rockfall, Middlesex County, Burns caught one male of *T. lineola* on June 20, 1964. He saw no others at that time; but on June 25 we visited this spot, and Burns got another male. He briefly checked the Rockfall locality for *T. lineola,* without success, on June 26 and 27, and July 11, 1964.

The other species of skippers with which we found *T. lineola* flying in 1964 were, at Portland, *Ancyloxypha numitor* (Fabricius), *Polites coras* (Cramer), *P. mystic* (Scudder), *P. origines* (Fabricius), *P. themistocles* (Latreille), *Pompeius verna* (Edwards), *Poanes hobomok* (Harris), *Euphyes bimacula* (Grote & Robinson), *Epargyreus clarus* (Cramer), *Achalarus lyciades* (Geyer), *Thorybes pylades* (Scudder), and *Pholisora catullus* (Fabricius); and, at Rockfall, *Nastra lherminier* (Latreille), *Ancyloxypha numitor, Hesperia sassacus* Harris, *Polites mystic, Wallengrenia egeremet* (Scudder), *Pompeius verna, Poanes hobomok, Thorybes pylades, T. bathyllus* (Smith), and *Pholisora catullus.*

The localities at which we discovered *T. lineola* are 7.6 miles (rectilinearly measured) apart, on opposite sides of the Connecticut River. In both localities, the skipper occurs in highly disturbed habitats—particularly "waste" areas flanking roadways and supporting, among other grasses, timothy (*Phleum pratense*). Since *T. lineola* is known from two distinct spots and is known to have been at one of them for two consecutive years, it is evidently established in Connecticut. However, the many man-hours spent specifically in seeking out this skipper in 1964 produced a total of but 9 specimens—all males. We think the present low population density is better ascribed to recency of invasion than to any possible marginal qualities of the lower Connecticut River valley for the continued survival of this species.

THREE LETTERS FROM J. A. B. D. DE BOISDUVAL TO W. H. EDWARDS, AND THE TRUE IDENTITY OF *MELITAEA POLA* BDV. AND *MELITAEA CALLINA* BDV.

F. Martin Brown[1]
Fountain Valley School, Colorado Springs, Colo.

While reading the letters written to Henry Edwards by William Henry Edwards I found several that contained notes about specimens that Boisduval had sent to W. H. Edwards. These were types of Boisduval's species named from material sent to him from California by Lorquin. This recalled to me three letters that Boisduval had sent to Edwards and that are preserved in the Archives of the State of West Virginia in Charleston. I had skimmed these letters and had noted that in them Boisduval expressed his opinion on many interesting facets of taxonomy. I present here translations of the letters, in more or less idiomatic English, prepared for me by Mde. Marcelle Róbert Perry, a friend and associate of mine for over a third of a century. Words in brackets I have added to explain some of Boisduval's phrases.

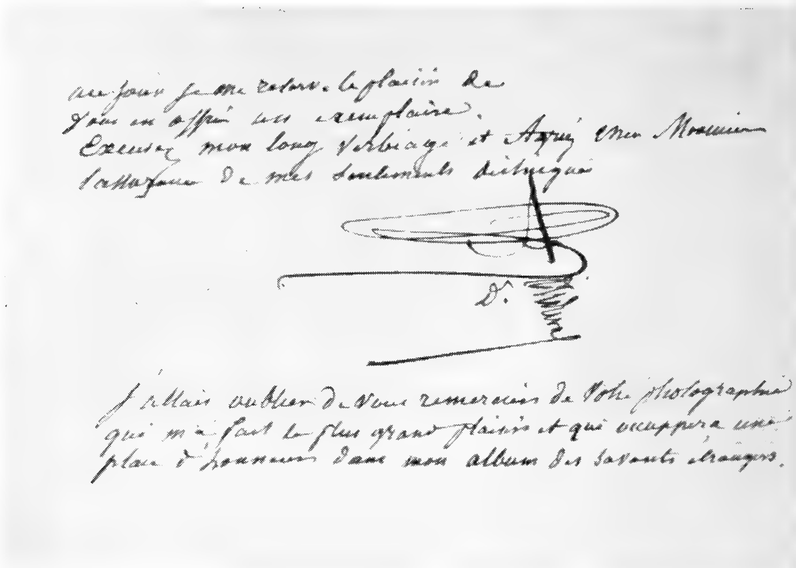
Boisduval's handwriting is almost microscopic, but, with few exceptions, quite legible. He crammed onto a small page as much as can be typed, double-spaced, on something over a full sheet of paper. Edwards' handwriting, on the other hand, is large and flowing and very often almost unreadable! Boisduval's signature is undecipherable. It is essentially a rubric. Because it is so strange I reproduce (Fig. 1) with the hope that it may bring to light other letters of this great lepidopterist. The correspondence took place when Boisduval was 74 years old and Edwards 51. The volume that Boisduval mentions in both of the letters written in 1874 is the second of his "Species Géneral des Lépidoptères." The first was published in 1836, the second in 1874.

The box of specimens that Boisduval acknowledged receiving in his first letter to W. H. Edwards is mentioned in a letter dated from Coalburgh, W. Va., 15 April 1873 to Henry Edwards in San Francisco. I quote the pertinent part of this letter.

". . . And now I have some items of interest for you. Dr. Boisduval has lately sent me (lent) his types of several Lycaenidae that I could not make out, through Scudder, and I have been comparing with my specimens.

"*Nestos* is *Cilla* Behr

[1] This study was pursued while investigating W. H. Edwards' types of Melitaeinae with the aid of N.S.F. Grant GB 2741.



au jour je me retrouve le plaisir de
vous en offrir un exemplaire.
Excusez mon long verbiage et Agréez cher Monsieur
l'assurance de mes sentiments distingués

J'allais oublier de vous remercier de votre photographie
qui m'a fait le plus grand plaisir et qui occupera une
place d'honneur dans mon album des savants étrangers.

Explanation of Figure 1

Boisduval's signature, or rubric, reproduced from a letter written to William Henry Edwards.

"*Erymus* is *Pardalis* Behr

"*Philemon* is *Anna* Edw. = *Argyrotoxus* Behr

"*Nivium* is *Calchas* Behr

"*Phileros* is *Helios* Edw.

"*Evius* is the Nevada form of *Pheres*, marked by me *Pheres* ? and received from you.

"*Enoptes* is same with one I sent you (of Wheeler's Arizona); which I have called *Libya*, but not described.

"*Rufescens* is a beautiful species of which Mead took one and called it a pretty var. of *Saepiolus* ♀. It is rufous and approaching fulvous about the margins, clear light brown below.

"*Lupini* I do not find among my specimens. It (♀ only) has fulvous [undecipherable word] lunules on the hind wing below, as *Battoides* has. So has *Glaucon*."

Paris, June 1st, 1873

Very honored Sir

I have received on time and in the best of condition, the Lepidoptera which I had sent you through my friend Mr. Scudder. It seems you are more exact that Mr. Grote to whom I had lent 5 *years ago* some Heteroceras from California, unique in my collection, which he hasn't yet been

able to send back to me for lack of opportunity, Vemit tempus aun . . . , but for you, Sir, who are a conscientious worker and whom I consider as the Hübner of North America, I have nothing, absolutely nothing I wouldn't let you have. All my collection is at your disposal. I received from Lorquin quite a while ago 4 specimens of my *Chionobas Californica*, 2 ♂ and 2 ♀. Three years ago, I gave my friend, Mr. Scudder, one of the males which he wanted very much to own. I have now a female, who is of course a widow, and I am only too happy to offer it to you for your collection; from this moment, she is yours—as soon as you have an opportunity, have her taken at my house, also whatever could be useful to you for your splendid book. About *Chionobas*, I received a while ago a ragged specimen of a species which the late Mr. Say had sent me under the name *Eritiosa*; have you known something under this name? It was in too bad shape to be able to recognize for sure. I wouldn't be surprised that this specimen belongs to *Chryxus*,[2] brought back from the Rocky Mountains by my late excellent friend, Edw. Doubleday *nescio*. I really believe that *Also* and *Oeno*, belong to the same species, but I don't think that the species of Greenland and the Far North, which I called *Bootes*, are identical with *Bore* of Lapland. Do you know well this last species in nature?[3] *Bore* ♂ has, like *Jutta*, a slanting shade ["ombre"—androconal patch?] on a spike ["épi"], a characteristic which I have never seen on any male of *Bootes*. Finally the species which is named *Baldur* is entirely different from *Jutta* of Lapland and Siberia. I am questioning Philippe Eveillé.[4]

I believe you are right to put together *Ajax* and *Marcellus* in spite of the difference there is in the coloration of the larvae and the length of the tail of the insects in the perfect state [imago]. In spite of the opposite opinion of Abbot, they are probably only seasonal variations. Where did you see that *Smintheus* DD and *Intermedius* Ménétriés were the same thing? Stupid people! The *Intermedius*, which I received from my late friend Ménétriés, have the base of the lower wing widely marked with red underneath, while there is nothing like it in *Smintheus*. *Intermedius* isn't a species in itself, it could be considered as a local modification of the *Phoebus* from which it differs only by the smallness of the eyespots. I am saying nothing of your varieties *Sayii* and *Behrii*, which I have never

---

[2] The name, *eritiosa* Boisduval, 1832, usually is considered a synonym of *semidea* Say, 1828. Boisduval's suggestion is revealing. Say was a member of the Long Expedition to the base of the Rocky Mountains in 1819–1820. The expedition penetrated the Front Range of Colorado at Pikes Peak. Say may very well have taken *chryxus* at that time. Although most of Say's insects collected on this expedition were lost on the homeward trip, he may have saved a few.

[3] Boisduval's use of "in nature" needs some explanation. He did not mean "in the field," as we might say today. He meant knowledge from an actual specimen rather than knowledge from only the written description.

[4] I have been unable to identify this person. The spelling of the last name is somewhat questionable.

seen; it isn't the same with *Nomion.* It is a big species of the best known, whose anal angle is marked with a big black spot in form of an anchor. You do not know for sure the Parnassians. I don't know the *Pieris; frigida, yreka, marginalis, occidentalis* and *Beckerii*; nor the *Colias: Keewaydin, Christina, ariadne, occidentalis, Emilia, Edwardsii, chippewa* and *Behrii.* I don't know at all the *Argynnis: nokomis, Behrensii, halcyone, nevadensis, atlantis, rupestris, hesperis, Morrisii* and *Bischoffi.* About the *Argynnis* I think we are making too many species. I can't admit consciously as very distinct, *mormonia, Eurynome* and *nenoquis.*[5] What do you think of this? Here *niobe* and *pales* offer many more variations according to the localities they come from. The former entomologists had made of them separate species that we had to put together again. *Edwardsii* seems to me a good species very near to *Calippe* [sic]. Your *Epithore*[6] isn't the same as the one I described. Yours is much smaller and is much nearer *Frigga* than *Epithore.* It is evidently new. I put it, in spite of its poor shape, in my collection under the temporary name of *friggiodes.*

You mention a whole new series of *Vanessa,* of the sub-genus *Grapta,* most of them are unknown to me. I fear that all of these species may be set on shaky bases. I only own from the United States *Comma, progne, interrogationis, faunus,* and *zephyrus* that you have been kind enough to send me. This last, even, resembles a great deal *faunus. Erebia epipsodea* is a very good species, so much more interesting that this genus is not abundant in North America. I agree with you about the *Polyom. Thoe* and that it is on wrong information that Cramer has considered his *hyllas* as coming from Smyrna. However, one must realize that there are in the Middle East many species of the genus *Polyom.* But I have never received from the part of the world any female which had any resemblance to *hyllas.* I have never seen *Apatura alicia* and *proserpina.* You are making a mistake about *Eulalia.* A specimen that Doubleday gave me, and which is still in my office, doesn't offer an atom of difference with those I got from Lorquin [from California]. About *Bredowii* Hubn., of which I received a specimen from Mexico, it is a very close species which differs from *Eulalia* only because the tawny spot of the top of the first wings is triangular on either [upper and lower] side.

I am not telling you anything about the Hesperides. There are, maybe, more than 190 species in the vast territory of the United States.

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[5] W. H. Edwards had Reakirt's type of *nenoquis* and identified it as a specimen of *Boloria dia* Linnaeus, a European species included by Lorquin the younger in a shipment of Californian butterflies to Reakirt.

[6] This does not apply to *epithore* Edwards. At this time W. H. Edwards was trying to determine the material collected in 1871 in Colorado by T. L. Mead. He had returned to Behr the specimen that was the type of *epithore* Edwards and was confused by specimens that we call *Boloria frigga sagata* Barnes and Benjamin.

Now, dear sir, I must thank you for the species you sent me, of which I saw the appearance for the first time. I don't know Dr. Behr, but I heard a lot about him through the late Lorquin. Is it in order not to be mistaken for his compatriot the Great Beinley[7] that he writes his name thus and not with two Es (Been). About Mr. Reakirt I have nothing to say, only that some talk is going around about him which are probably only abominable calumny.[8]

I don't need to tell you again, very honored Sir, that all you may want for your remarkable work will be yours for the asking. Keep on with your work. You will help science a great deal, if it continues to be as careful as what I saw of it in the hands of Mr. Scudder. Your synoptic catalogue of the Rhopalocera of the United States has given me great pleasure in putting under my eyes the amount of what is known up to now of native insects of this vast country. Only God knows how many new species there are to be discovered!

I am publishing now a Species Géneral of all the Sphingides known on this globe, Sessides and Castnides with a few colored pages. As soon as this will see the day, I reserve for myself the pleasure of offering you a copy.

Excuse my long letter and accept, dear Sir, the assurance of my distinguished sentiment,

/s/ Dr. Boisduval

I almost forgot to thank you for your photograph which pleased me very much and which will occupy a special place in my album of foreign scholars.

Several excerpts from letters written to Henry Edwards by W. H. Edwards are illuminating at this point and give added meaning to the second Boisduval letter.

Coalburgh, W. Va., January 16, 1874: ". . . I am just sending Boisduval a lot of new species and ask him to send me types of *Epithore, Mormonia, Egleis* and most of his *Melitaea*. Also the ♀ of *Ch. Californica* which he promised me last June. . . ."

Coalburgh, W. Va., March 13, 1874: "Boisduval writes 20th February that on 16th he sent me a box with all the species I applied for: that is *Ch. Californica* ♀ and several *Argynnis* and *Melitaea*, among them *Epithore*. . . . He remarks on nearly all I sent him. . . ."

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[7] I have been unable to identify this person.
[8] See Brown (1964).

Brooklyn, N. Y., March 29, 1874: ". . . Boisduval's box is in Philadelphia as I hear from Cresson. I shall get it Tuesday and hope to find some good things in it. At any rate to learn what *Epithore* is."

Paris, 20 February 1874

Dear Sir

Your parcel arrived in very good shape. Thank you so much for the species you gave me. You will receive very soon the package with all the species you want to see as *types*. You can keep everything except for the species marked X, of which I own very few. I made you wait a little, but that is due to my being very busy with the printing of my "Species" of the Sphingides family in which you are not too interested but which interest me to the *n*th degree. Among the species you sent me there are some new one for me, *Argynnis helena* is a charming one which takes its place next to *selenia* and *Euphrosyne*. *Atlantis* is really the same as the species I owned under the same name. *Juba* and *Coronis* are identical and the same is true of *Alta*[9] and *Sonorae*. I am sending you the types described by me. I think we are making too many species of the genus *Argynnis*. Our European species, which I raised from the caterpillar, vary a great deal and, so, *Niobe* has sometimes some silvery spots and sometimes yellowish ones; it is the same also for our *Adippe*. I could believe easily that *Mormonia* and *Egleis* are also only varieties; it could be true also that *irene*, *hydaspe* and maybe your *hesperis* are only local modifications of the same species. One should be there to study the problem very closely and raise the caterpillars. Your *proserpina* is a very curious dimorphism. I only wonder why it appears with *Arthemis* rather than with *Ursula*. In fact these two types (*Ursula* and *Arthemis*) are varieties one of the other, which I have been tempted more than once to unite. Their caterpillars, drawing of which I have, resemble each other completely. The *Colias Scudderii* is a new species to me. It is very near our *palaeno* but very distinct by the yellow nervures which divide the border. Your *Sat. charon* is very near the one I described under the name *Oetus*. Your *Ridingsii* is a charming small species near *Arethusa* [*Arethusana arethusa* Esper]. *Ch. Uhleri* is also new, as is *Sat. Meadii*. *Mel. camillus* and *minuta* are new species. I have owned for a long time *Vesta* under the name *Texa* [Boisduval manuscript name]. I received it also from Texas.

The *Vanessa*, sub-genus *Grapta*, are very near each other. If I can judge from our European species, they must vary a great deal. I am

[9] This is a manuscript name that Edwards decided not to use since it was synonymous with a previously published name.

sending you three varieties of our *C-Album* whose letter C is smaller than in the usual specimens, plus a variety of our *L-Album* (*triangularis*). *Comma* and *Dryas* are certainly one species. What do you think of *Zephyrus* and *faunus*? It is necessary to look very closely to tell them apart. *Satyrus* has completely the shape of our *C-Album* but it is clearly different by the letter C, bigger and a little silver colored. Some one sent me *Hylas* a long time ago under the name *progne*. What is then your *progne*? I would like to have a specimen of it. According to Cramer and Godart, it is from the State of New York and Jamaica; have not the author's mixed two species? What we have in French collections under the name *progne* doesn't look very exactly like the drawing on pl. 5 of Cramer. Is the true *progne* indigenous to the United States, or isn't its habitat rather in the Antilles?[10] That is the question.

I forgot to put in the box some *Parnassius Phoebis* in order to show you that the *Smintheus* is an entirely different species. I would love to see *Sayii* and *Behrii*, also the female of *Smintheus*. Doubleday has figured a small *Anthocharis* [*creusa*] from the Rocky Mountains near *Belia*. Do you know it?

I end here my letter, [etc., etc.]

/s/ Dr. Boisduval

Keep on with your work. In a century we won't know yet all the Lep. Rhopaloceres of the United States. Your box left on the 16th.

Two letters from W. H. Edwards to Henry Edwards are important at this point. They bear upon Boisduval's third letter. There is repetition of some information which I omit from the first letter of the two since it is better set forth in the second.

Coalburgh, W. Va., April 3, 1874: ". . . I brought Boisduval's box with me from Philadelphia. He has sent types of all his *Argynnis* and some *Melitaea* and of *Satyrus Oetus*. The latter I do not think is *silvestris*. . . . But the gem of the lot is the ♀ *Chionobas Californica*. It is bright chrome yellow, brighter than Behren's male [of *iduna*] and all one shade of color. Below markings clearer than on any of the several species I have seen. It was perfectly fresh when taken, but has lost one antenna and legs. I will put this sp. [specimen?] and ♂ *Gigas*[11] on Plate II of *Chionobas*."

The second letter, dated April 4, 1874, from Coalburgh, I quote in its entirety and also Henry Edward's penciled notes made from the Boisduval types.

[10] No species of *Polygonia* is known from the West Indies today.

[11] In a letter dated March 8, 1874, W. H. Edwards told Henry Edwards that he had received from A. G. Butler at the British Museum a colored drawing of the unique type of *gigas* Butler 1868. The specimen is in the British Museum (N. H.) and is type No. 3846.

"I have taken time this noon to go over Boisduval's insects and you will be desirous of hearing the result.

"*Callippe* is same as in Butt. N. A.

"*Juba* is *Coronis* Behr.

"*Hydaspe* is *Zerene* Butt. N. A.

"*Adiante* is what we call so.

"*Egleis* is Behr's No. 4 but that not having been named, *Egleis* holds.

"*Mormonia* is Behr's 5 = *Montivaga*

"*Irene* I do not know. Size of *Montivaga*, perhaps a little larger. Shape of *Coronis*.

"*M. Sonorae* is *Gabbi*

"*M. Epula* is *Mylitta* Edw.

"*M. Orsa* is *Montana* B.

"*M. Palla* is what we so call.

"*M. Helicta* may be var. of *Palla*.

"*M. Pola* & *Calina* I don't know. Both probably Mexican.

"*A. Epithore* is your 4282 sent me as *Epithore*.

"*S. Oetus* looks like pale *Charon* Edw. & I think is that species.

"Great thing to get right."

/s/ W. H. Edwards.

Henry Edward's penciled memorandum attached to this letter is headed ""Edwards Butts & Bdvl types." I have extracted from this the notes that apply to Boisduval's types.

"*Epithore* type is a ♀.

"*Epula* Bdv = *Mylitta* Edw.

"*Palla* type is a ♂

"*Orsa* = *Montana* Behr

"*Helicta* = *Hoffmanni* Behr

"*Collina* I think Mexican. It is smaller than any California species I know.

"*Pola* may be a new species, but I doubt it. It looks like a suffused specimen of *Gabbii*. Markings of under side do not in any way differ from these of *Gabbii*.

"*Arg. Irene* Bdv. is exactly the same as my No. 3500, agreeing with type in every particular. Have always thought this an extreme var. of *Zerene*.

"*Mormonia* Bdv. My specimen 2386 agrees with the type, but I doubt the validity of the species.

"*Egleis* Bdv. is different from any species I have, but I think it only a variety.

"*Sat. Oetus* is new to me, and very distinct. Like *Satyrus* above, and

about same size, but underside more repeatedly [?] mottled, with some pale darkish at base of secondaries, the submarginal ocelli (2) being black with white distinct pupil and enclosed in a black disk [?]."

Paris, 15 June 1874
22 rue Fosses St. Jacques.

Very honored Sir

It was only on my return from the provinces [farm?], where I was sick for a few weeks, that I found your letter. I thank you for the data it contains; I will know how to profit by them. I am delighted the little box got to you in good condition and that in it were things that could please you. You tell me that your *Mylitta* is the same as my *epula*. Kirby, about which anyway, the work is full of errors, unites my *Epula* with *pratensis* of Behr, on another page he makes two distinct species of *Montana* and of *Orsa*. What I find amazing in the work we are talking about is that he puts together my *Pulchella* and *Tharos* which are two very different species. Kirby, always the same Kirby, brings together *Mormonia* and *Nenoquis* of Reakirt, and *Sirene* and *Montana* of Behr. I really believe that this man, who went to all kinds of trouble to compile a catalogue for the people who work, has never seen in nature [alive or dead] the species he is talking about. Anyway, we must be thankful to him for a work which must have made him do a lot of research and a great expense of time.

I am happy to know that you have seen the caterpillars of the *Vanessa (Grapta) satyrus, faunus, comma, Dryas,* and *Zephyrus.* It is the only way to recognize the validity of a special species.

When the opportunity presents itself I would like to receive the species which you call *progne* to compare it with the one from the West Indies [Cramer's figures?]. If you could also dispose in my favor a female of *Smintheus* I would be very grateful to you; she must be very near the one of *Intermedius* from Siberia. The pouch of the oviduct of the females offers sometimes an excellent characteristic. For example, that organ is entirely white in *Clarius, Clordius* and several others, as it is in *Mnemosyne* and *Stubendorffii.*

All my winter has been spent in the printing of my "Species" of the Sphingides, Sessides, Thyrides and Castnides. It is a big book in octovo, with illustrations (568 pages). The work has been complete since March, the editor hasn't yet published it on account of the tardiness of the artists in charge of the engraving and coloring. I have worked for more than 20 years!

Even though you may not be interesting in the Lepid. heteroceres I want to send you a copy as a souvenir, also a copy of my monograph of the Agaristides.

In spite of all my work and all the material I have at my disposal, there must be, without doubt, still many species which I do not know. There are two species native to the U. S. which I have never seen in *nature: Lucitiosa* and *Versicola*. The same is true about *Ellema pinensis* [*pineum*] of Lintner which seems to me to be very near *Harrisii*, if it isn't a variety of it.

I am asking also, if it is possible for you to give me the address of Mr. Grote. It has been more than six years that he borrowed from me some unique species from California (Heteroceres) and he has neglected to send them back to me. I can't understand it. When one lends me any specimens I keep them about a short time and I hurry to give them back to the people who were helpful to me. He published them all and he must have had many opportunities to send them back to me. I had already begged Mr. Scudder to remind him of it; probably he did nothing about it because I am still without news of my unique species.

I am ending, dear sir, [etc., etc.]

Your very devoted servant
/s/ Dr. Boisduval

I am sending you, enclosed, a fragment of proof of my Species which will prove to you that the printing is finished as I have told you before.

Melitaea pola Boisduval
Ann. Soc. ent. Belg. 12: 56, "1869" [1868?]

The specimen that Boisduval sent to Edwards as *pola* is in the Edwards Collection at the Carnegie Museum at Pittsburgh, Pennsylvania. It is not at all like specimens currently passing under that name. It fits much better Boisduval's original description than does the specimen figured by Oberthür and considered by him to be the type of the name. Barnes and McDunnough introduced to American rhopalocerists the current concept of the name *pola* in 1916 (p. 92). This is based upon McDunnough's examination of Boisduval material in Oberthür's collection in Paris. Actually it was McDunnough who selected the specimens figured by Oberthür as Boisduval types. The specimen selected by McDunnough and figured by Oberthür is in the Barnes Collection at the United States National Museum in Washington, D. C.

I present here photographs of the two "types" and Boisduval's original description of *pola* (Figs. 2, 3).

"44. **Melitaea Pola,** Boisd.

"*Alae supra sub-obscuriores, nigro fulvo et ochraceo variæ; posticæ subtus maculis basalibus fasciique duabus flavidis, media linea nigra divisa.*

"De la taille de notra *Athalia* et très voisine de *Palla* dont elle diffère par les caractères suivants: Dessus des ailes plus obscur avec les parties fauves ochracées vers le melieu; la bande médiane jaune du dessous des inférieures coupée longi-

Explanation of Figure 2

The holotype of *Melitaea pola* Boisduval in the Carnegie Museum, Pittsburgh, Pennsylvania. The lower left label is in Boisduval's manuscript. The pencilled label at right was written by Holland or Avinoff. Natural size. Photography by dos Passos for A.M.N.H.

tudinalement par une petite ligne noir et no bordée par cette ligne. Nous n'avons vu qu'un seul individu pris en Sonora."

The specimen sent to Edwards was marked with an X, indicating it was to be returned. Boisduval had died (1879) before Edwards got around to returning it. It was Boisduval's single specimen from Sonora. It cannot be otherwise than the type of the name *pola*. Thus this specimen, the holotype, must replace the McDunnough–Oberthür lectotype which represents a different species, *arachne* Edwards 1868. Article 74 of the Code makes this action mandatory.

Higgins (1960: 389) based his interpretation of *pola* on Oberthür's figure. He, however, guarded himself by a caution that suggests clearly he was not satisfied and recognized the lack of agreement between Oberthür's figure and Boisduval's description.

Melitaea callina Boisduval
Ann. Soc. ent. Belg. 12: 54 "1869" [1868?]

In his recent Synonymic List, dos Passos (1964: 82) placed *callina* Boisduval 1869 as a synonym of *collina* Behr (= *Phyciodes mylitta* Ed-

EXPLANATION OF FIGURE 3

The McDunnough–Oberthür pseudotype of *Melitaea pola* Boisduval in the United States National Museum, Washington, D. C. The lower, second from right label appears to be in Boisduval's manuscript. The label "Minuta/Col°" is in W. H. Edwards' manuscript. The figure at left is from Oberthür's publication. Natural size. Photography by dos Passos for A.M.N.H.

wards 1861) as a misspelling of Behr's name. This is far from the truth of the matter. He also accepted *callina* Boisduval 1869 as a subspecies of *Melitaea elada* Hewitson 1868. I have been unable to find any other reference to *callina* by Boisduval in 1869 other than his description of the *elada*-like insect. Barnes and McDunnough (1916: 92) wrote: "After a careful study of the figure of the sole remaining type from Mexico (Oberthür, Ea. de Lep. Comp. IX, (2), Fig. 2185) we have found that the species agreeing best with this figure is the Texan one known heretofore as *ulrica* Edw. (*imitata* Stke.); . . . the Sonoran types being lost we think it advisable to restrict the name to the Mexican type . . ."

What Barnes and McDunnough did not know, although they had studied the material in the Edwards Collection, was that one of the original "Sonora" syntypes of *callina* is in the Edwards Collection. This is the specimen sent to Edwards by Boisduval in 1874. It is marked with an X on the label attached by Boisduval indicating that the specimen was to be returned because he needed it to hold the name in his own collection. The Oberthür "Mexican type" is in the Barnes Collection at the United States National Museum. I figure both of the "types" here. The original

EXPLANATION OF FIGURE 4

The Higgins' "Holotype" lectotype of *Melitaea callina* Boisduval in the Carnegie Museum, Pittsburgh, Pennsylvania. This is one of Boisduval's Sonoran specimens. Natural size. Photography by dos Passos for A.M.N.H.

description of *callina* Boisduval follows and should be compared carefully with the figures of the two "types" (Figs. 4, 5).

"39. **Melitaea Callina,** Boisd.

"*Alæ fulvæ supra lineis numerosis transversis limboque communi fuscis; fimbria nigricanti albido intersecta; posticæ subtus fulvo albidoque fasciatæ.*

"Cette Mélitée de la taille de notre *Nemeobius Lucina* se rapproche beaucoup par la porte de nos petites espèces européenes. Ses quatre ailes sont fauvres avec des raies transversales sinueuses assez rapprochées; ou si l'on veut elles sont brunes avec des raies fauves interrompues; la bordure est noirâtre ainsi que la frange qui est entrecoupée de blanc. Le dessous des premières ailes est fauve, principalment vers la base avec quelques lignes noires ondulées, il est brunâtre vers l'extrémité avec une rangée de taches fauves et quelque taches blanches dont une, un peu plus grande, est un peu sagittée. Le dessous des secondes est fauve, marqué de bandes blanchâtre, liserées de noir, dont celle de l'extrémité est formée de taches un peu sagittées.

"La femelle ressemble au mâle, sauf qu'un dessous le sommet des ses ailes supérieures offre des taches blanchâtre plus indiquées et plus nombreuses.

"Pris dans la Sonora, nous avons reçu du Mexique plusiers individus et cette même espèce."

From this it is quite evident that the Sonoran specimens were the basis of the original description. The surviving syntype from Sonora fits the description far better than does the surviving Mexican specimen. Barnes and McDunnough (1916) thought that Boisduval has a mixed series and the Sonoran and Mexican materials were different. The Mexican specimen from Oberthür is very close to *ulrica* Edwards 1877. Thus Barnes and McDunnough did the only thing possible for them at the time. This was to suggest that *callina* Boisduval 1869 supplant *ulrica* Edwards. This they

Explanation of Figure 5

The McDunnough–Oberthür "Type" lectotype of *Melitaea callina* Boisduval in the United States National Museum, Washington, D. C. This is one of Boisduval's Mexican specimens. No labels appear to have been written by Boisduval. [The figure at left is from Oberthür's publication.] Natural size. Photography by dos Passos for A.M.N.H.

did in their 1917 Checklist. In his checklist of 1938 McDunnough considered *callina* Boisduval a subspecies of *elada* Hewitson 1868. Higgins (1960: 452–453), in the most recent evaluation of this group of names, considered *callina* Boisduval a synonym of *elada* Hewitson on the basis of the Carnegie Museum specimen, which he named "Holotype." It actually is the lectotype, since Boisduval had at least a pair of specimens from Sonora. The precise order of priority for *elada* and *callina* needs to be established. There is some question about the date of publication of both Hewitson's work and the first part of the *Annales* in which Boisduval published his name.

It is obvious from Boisduval's original description that he considered the Sonoran material to be typical *callina* and that the Mexican specimens were secondary supporting series. I believe that it can be argued that the discovery of a Sonoran specimen labeled by Boisduval in 1874 sets aside the Oberthür–McDunnough "type" of 1911, based on the sole remaining syntype of the secondary series. Barnes and McDunnough reluctantly accepted the "Mexican" material as type in the absence of a Sonoran specimen. Adoption of the Sonoran specimen as lectotype at this time is at variance with Articles 73 and 74 of the Code (1964).

Article 73 (c) can be interpreted to include both the Sonoran and

Mexican specimens of Boisduval as syntypes from which a lectotype must be chosen. Article 74 (a) (i) states "The first published designation of a lectotype fixes the status of the specimen, but if it is proven that the designated specimen is not a syntype, the designation is invalid."

The ultimate decision rests upon the interpretation to be put upon Boisduval's wording of the last sentence quoted from him above. If this is interpreted to restrict the syntypes to the Sonoran specimens, then Higgin's designation of the Carnegie Museum specimen is valid. If the wording is not considered restrictive, then the Oberthür–McDunnough selection of a "Mexican" specimen must be supported. I have advised Higgins of the situation and recommended to him that he take appropriate action to settle this nomenclatorial problem for the sake of stability.

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BOOK NOTICE

EARLY STAGES OF JAPANESE BUTTERFLIES. By Dr. Takashi Shirozu. Photography by Akira Hara. Vol. I, iv + 142 pp., 60 col. pls., 1960; Vol. II, 139 pp., 60 col. pls., 1962. Hoikusha Publishing Co., Ltd., 20, 1-chom, Uchikyuhoji-machi, Higashi-ku, Osaka, Japan. $12.50 (surface mail), $18.75 (air mail).

Of 216 native and migratory species in Japan, 196 are illustrated in color photography, including all but three of the native species. The plates show egg, larva, pupa, and adult, often from more than one angle; they are exceptionally clear and true in color. Special features include illustration of the oviposition of *Aporia hippia japonica,* emergence of several species, and front view of the heads of 92 species. This is a monumental work on the early stages of Japanese butterflies. The author is Professor at the Biological Laboratory, General Education Department, Kyushu University, Fukuoka, and a member of the Lepidopterists' Society. The photographer is a member of the Entomological Society of Japan, and one of the best photographers of insects in Japan. The author and photographer had nationwide cooperation of Japanese lepidopterists, who supplied living materials.

Although the text is in Japanese, there is an index of the Latin names which are also given on the plates, and the plates themselves really tell much of the story. They are indeed remarkable, especially those of the eggs, which are much enlarged. Much other information on the early stages of Japanese butterflies is available in papers published in the *Lepidopterists' News* by Mr. T. Iwase (vol. 7, p. 45; vol. 8, p. 95; and vol. 9, p. 13), in the *Journal of The Lepidopterists' Society* (vol. 18, p. 105); and by Dr. T. Kuzuya in the *Journal* (vol. 13, p. 175).—Takeshi Kuzuya, *3d Dept. Intern. Medicine, University of Tokyo, Hongo, Tokyo, Japan* and E. J. Newcomer, *1509 Summitview, Yakima, Wash., U. S. A.*

AN INEXPENSIVE APPARATUS FOR PHOTOGRAPHING MOUNTED SPECIMENS

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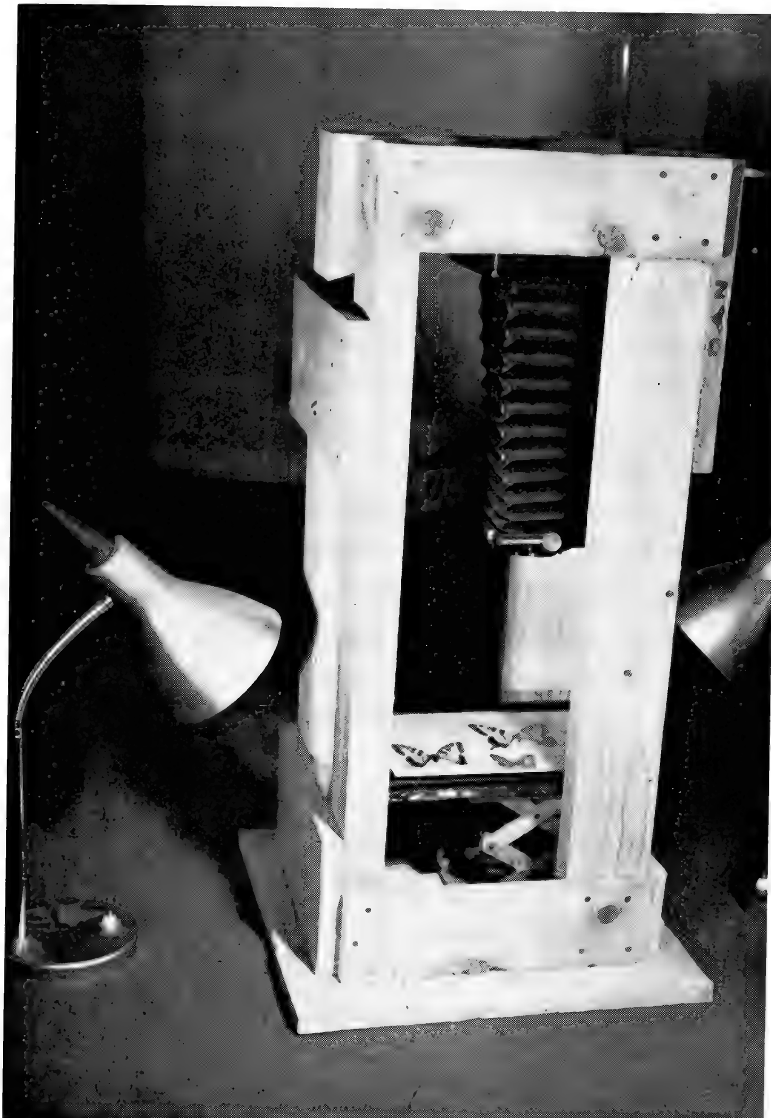
A considerable investment is required for a new, high-quality camera of small film size (e.g., 16 mm) with close-up lens attachment, or, alternatively, for a large, supported view camera with integral height adjustment and focusing devices. Photoflood lamps or, especially, an electronic flashgun, normally add to the expense. Therefore, the following procedure, which utilizes an inexpensive camera, requires no special lighting facilities, and gives excellent photographs, may be of interest to those who are not inclined to make a multihundred-dollar investment in photographic equipment.

The basis of the inexpensive arrangement to be described is the fact that a sharp image is obtained without a *very* expensive lens because the film size is large and the lens is stopped far down (aperture minimized). Brilliant illumination is unnecessary because the subject is motionless and the time exposure may be as long as needed.

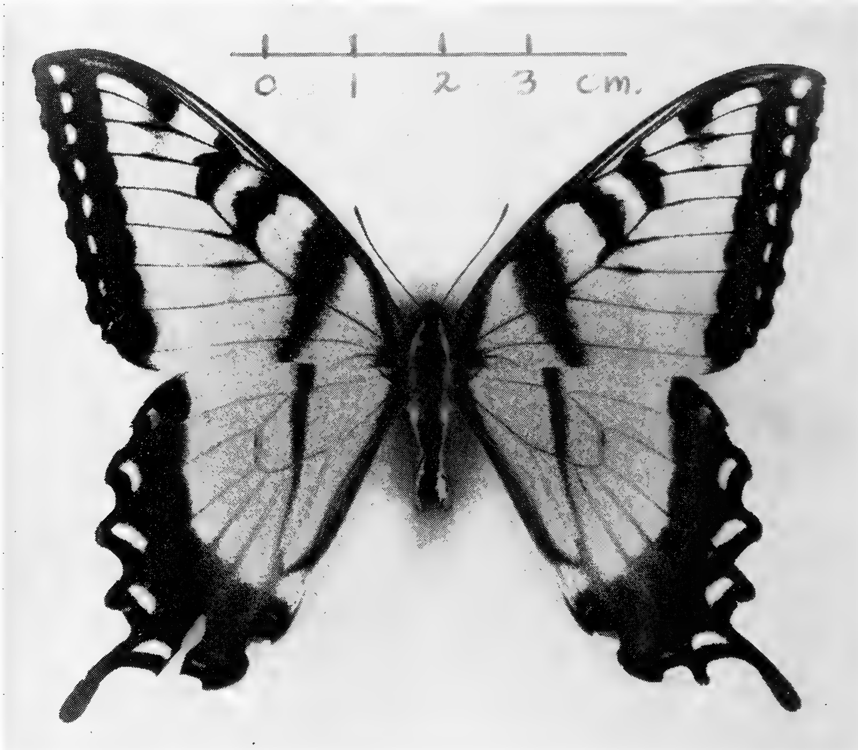
The most expensive item in the apparatus shown in Fig. 1 was the camera, an old Watson Speed Press using 4- × 5-inch cut film and equipped with a f/3.5 (range: f/3.5–f/32), 4 cm lens made by the Jos. Schneider Co., Germany. (The f-number represents the relation of the aperture to the focal length, i.e., f/32 means that the aperture is 1/32 of the focal length, which for this particular lens is about 14 cm.) This camera was purchased for $35 in one of the many photographic shops in New York City, the main criteria for selection being that the shutter functioned for time exposures (all that is needed) and that the bellows was in good condition. The camera was mounted vertically, using a wooden frame as shown, so that the distance from the lens to the specimen could be adjusted from 9 inches, making the field of view 3 × 2⅜ inches and the magnification about 1.7 (a feature of this procedure is that contact prints are often suitable without necessity of enlargement), to 14 inches, making the field 7 × 5¾ inches and the magnification about 0.7. The photo (*Papilio glaucus*, male, Aug. 23, 1964, Convent, New Jersey) shown in Fig. 2 was taken at a lens-subject distance of 11 inches.

The procedure is as follows. The subject, suitably in a Riker mount on cotton or black velvet as desired (the specimen shown was on cotton), is placed on the adjustable platform (a laboratory jack in this case but other arrangements may be designed). The glass over the specimen presses it



An inexpensive apparatus for photographing insect specimens.

flat and keeps it in the same focal plane; reflection of light from the glass did not constitute a problem, but the glass may be omitted, of course, if desired. Next, the two ordinary lamps (with 100 watt bulbs) are turned on (a certain amount of heat is produced, so the lamps are kept off between exposures), and the diaphragm is opened fully to make



Photograph of specimen in Riker Mount, taken by a method described in the text.

a bright image on the ground glass. After focusing by adjusting the height of the subject, the diaphragm is closed to f/32, a cut-film holder with Kodak Plus-X Pan sheet film (4×5 inches) is inserted, and a 30-second time exposure is made.

If one desires the film is easily developed at home (providing that a place of total darkness is available) by following the Kodak Company's instructions, with continuous, vigorous agitation during the development step. For printing, a contact print box with a 7.5 watt bulb is satisfactory; a contact (illumination) time of 25 seconds with Kodak Velox F-3 paper (which gives better contrast than the F-2 grade) was used for the picture shown, the Kodak instructions being followed. The prints are rolled onto a ferrotype plate and when they have been released (1.5–3 hours) are pressed flat on a blotter for further drying. Of course, the developing and printing may be assigned to a professional photographic service, but one may find that best results are achieved by doing the work, especially the printing, personally.

ECOLOGICAL AND BEHAVIORAL NOTES ON *HESPERIA METEA* AND *ATRYTONOPSIS HIANNA* (HESPERIIDAE)

Arthur M. Shapiro
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The ecological associations of a number of the northeastern Hesperiidae have received relatively little attention in print. The lack of published information has handicapped many workers in their attempts to find the insects, and thus hampered the expansion of our knowledge of them. *Hesperia metea* Scudder and *Atrytonopsis hianna* (Scudder) have long been cases in point. Although both were described about a century ago, their life histories remain largely unknown, and their ecology and distribution but little illuminated. The present paper offers observations on the ecological associations, flight period, and behavior of these two species as observed in southeastern Pennsylvania and in New Jersey.

Hesperia metea Scudder

No records of this species have been published for Pennsylvania. Its occurrence there has generally been cited on the basis of a quotation in Tietz (1953) from Williams, who merely postulated its occurrence "within fifty miles of Philadelphia." Therefore it is noteworthy that recent records show *metea* is a resident in at least the following Pennsylvania counties: Philadelphia, Montgomery, Bucks, Chester, Delaware, and Lancaster (the last on the authority of George Ehle, personal communication). In New Jersey it occurs at least in Burlington and Ocean counties.

The ecology of *metea* in Pennsylvania may be taken as more typical than that in New Jersey, for most of its range. The writer has obtained a long series of *metea* from several colonies within the city limits of Philadelphia and in the surrounding counties. The physiognomy of these sites is uniform enough that it has been found possible to predict the occurrence of *metea* with considerable accuracy in a given site, even out of season.

In Pennsylvania, *metea* is very closely associated with the grass *Andropogon scoparius* Michx. This grass, commonly known as bunchgrass, bluestem beard grass, or fire grass, is a characteristic species of dry hillsides, woodland clearings, burn scars, and denuded or sterile sites. Its aerial method of distribution facilitates its occupying such situations rapidly. It reaches its greatest abundance on dry, open hillsides surrounded by woods; hills which open above the trees on at least one side.

This is the typical situation for *metea*. The butterfly is never found where the *Andropogon* is less than the dominant element of the herbaceous vegetation, nor where it is only a short-term component.

H. metea seems to occupy burned-over sites after the second year following the fire, *i.e.*, after *Andropogon* has thoroughly dominated the site. The skipper continues in residence until the grass is shaded out by tree growth or until other species of grasses become dominant, as sometimes occurs. In Pennsylvania, *Andropogon* is only locally a conspicuous element of oldfield vegetation, but on the rocky, poor soils of New England it is more important, and *metea* may occur in more open areas.

Aside from dry hillside clearings, *metea* in Pennsylvania also occurs in artificial clearings and on railroad tracks through woods, with the foodplant, but never in the abundance it reaches in hillside situations. It also occurs on the dry banks along the Pennsylvania Turnpike in wooded sections, but not commonly. Possible sites for *metea* may be recognized in autumn by the red–brown cast of the *Andropogon* stems forming a cover of dense clumps.

Andropogon, as earlier noted, is rarely in this area a permanent component of field vegetation, being only an occasional species on level, open terrain. One major exception is on the so-called "serpentine barrens" of Chester County, Pennsylvania, where the substrate is inhibitory to many herbaceous species and a peculiar grassland community results, of which *Andropogon* is a dominant species; *metea* is common here. I suspect it may also occur at Jennings Blazing Star Prairie in Butler County, another odd grassland where *Andropogon* is common.

Adults of *Hesperia metea* are very closely associated with the *Andropogon* plants and do not wander far from them. On hillsides, surrounded by woods, the *Andropogon* regularly occurs at the top and the upper half of the slope, with usually another grass, a species of *Panicum* of the *clandestinum* group, at the bottom and some *Triodia flava* in between. The *Panicum* is usually in partial shade, and the *T. flava* represents one of the most common grasses in the area, an important component of virtually every grassland type in eastern Pennsylvania but not a rapid spreader. In autumn of 1964 I examined two colonies of *metea* at the exact spots which had been noted on topo maps the previous spring. The density of *Andropogon* was measured by counting seed stems per square meter. It was found that in both colonies, over 80% of the specimens had been taken where the seed stem density exceeded $45/m^2$, which is a good indication of the intimacy of the association. It may, of course, also reflect a reluctance on the part of *metea* to fly downslope.

On railroad tracks, the *Andropogon* is typically mixed with *Panicum*,

the relative abundance of the two on a given stretch being related to the amount of shade; in these places *metea* is always commonest where the *Andropogon* is thickest, but the butterflies fly all along the track.

Male *metea* are aggressive, but there seem to be surprisingly few contacts among them considering the density which the species may reach in a small area. Close observation has led me to believe that a definite, though transient, territoriality exists. The males feed in the early morning and extend their range in the late morning, each occupying a specific site and, normally, returning to it when disturbed. These resting sites are usually open spots of bare ground among the tufts of *Andropogon,* occasionally projecting clumps of low vegetation. Male chases are very brief, rarely over two or three minutes, and seldom more than eight feet above the ground, unlike, for example, *Poanes zabulon* (Bdv. & LeC.). If a male is removed, its place will not be taken for ten or 15 minutes, suggesting that the number of drifting males, without territories, is quite low. As for the apportionment of these territories, it would appear to be on a first come, first served basis; and when a male already occupying a territory is challenged, it is always the original occupant that returns after the chase. The area defended by a single male varies with the vegetation and the population size, ranging from two feet square or more to ten inches square under overcrowded conditions, but becomes considerably greater in the air. The territories are rarely adjacent, the intervening spaces being used by transient males and by females which tend to stay just above the ground, and thus avoid pursuit.

If a male is disturbed by the collector, it typically will take flight but normally remain about a foot above the ground, twisting through the grass and other vegetation in a fast but skipping way, and returning within ten minutes or so to its original resting place via a circuitous route. When greatly alarmed, males fly higher and faster.

Females generally fly low, and rest during the heat of the day. When a male pursues a female that has wandered into the territory, the female generally alights quickly on a grass blade. The male follows, flying about the female for a few seconds; it then alights and walks up behind the female, fluttering slightly. At this point the female occasionally takes flight again, the male pursuing, but more often she flutters slightly, then steps sideways, allowing the male to advance up the leaf to a position parallel and adjacent to her. The male now curves its abdomen in toward the female, so that its extruded genitalia make contact with the caudal tip of the female. One or two repetitions of this behavior result in acquiescence by the female, and exposure of her genitalia is instantly followed by copulation. The male then sidles around the leaf until he

faces in the opposite direction to the female. The process on the leaf, just described, requires about three minutes. I covered two mated pairs with glass bottles in the field and found both still in copula two hours later. I do not know the normal full duration of copulation. Mating generally occurs around the noon hour, and seems more frequent in cloudy and cool weather than in full sunshine.

Males at rest in their territories generally perch with the forewings opened to an angle of about 70° and the hindwings to about 45°, but close the wings in cloudy weather or when slightly disturbed. Both sexes when feeding, and females when at rest, keep the wings closed over the back. During copulation the wings are closed as a rule, but twice I have seen the male open them to the "territorial" angle. Mated pairs frequently settle downslope from the territorial area. They are occasionally disturbed by other males. If the pair is at rest and the intruder airborne, the former will not normally take flight; when both are in flight, the pair usually land.

Ovipositing females appear on casual inspection to be flying in the normal, skipping manner six inches or so above the ground. They alight repeatedly, however, and crawl down into tufts of *Andropogon*. Here, the female turns around so that her abdomen points into the center of the tuft, and deposits an egg singly down low on a leaf, on the upper surface. I have never seen a single female lay more than one egg on a clump of the grass, although under crowded conditions it is likely that a number of females may utilize each clump. Females while ovipositing, and mated pairs, are much less wary and thus easier to observe than under other conditions.

Both sexes will fly into shade, but only for short periods. Females are much more active in cloudy weather than males, and may continue to oviposit while the males are at rest with wings folded. Neither sex flies in conditions of persistent overcast, however.

As might be gathered from much of the preceding discussion, the population density in various sites is quite variable. The highest I have seen is about 120 observed in an area of slightly over half an acre. Of course, most of these were concentrated into parts of that area with highest *Andropogon* density. The species is quite common in most of its localities. The frequent failure to find it probably results in part from ignorance of its habits and in part from its very short flight period. In Pennsylvania, the first males appear about May 6, the first females about May 12, with the overall peak about May 18, and hardly any males by the 25th. The last females are still on the wing about June 1. To be sure of finding the species, it is virtually necessary to look between May

12th and 22nd. Because of the sedentary habits of the butterflies, a thorough search is necessary; one may miss a small colony completely by only a few feet.

In the New Jersey pine barrens, the ecology of *H. metea* is necessarily somewhat different. There it is associated with *Andropogon scoparius* var. *glomeratus*, a grass found locally in sandy barrens. In clearings in the pine forest *metea* exists in conditions not unlike those in Pennsylvania, although rarely in large numbers. The greatest populations seem to be in the so-called "plains" area near the Lebanon State Forest, in the Mount Misery vicinity. This is a high, wind-swept area characterized by a curiously stunted open growth of pine and blackjack oak (*Quercus marilandica*); it is subject to frequent burning. *H. metea* flies in and out of the scrub trees and low vegetation, behaving much as it does elsewhere. Territoriality does seem to exist in the more open parts, but principally at ground level since the vegetation is not conducive to pursuit at high levels. The largest numbers are found on the recent burn scars, but the quick-sprouting pine and oak make these areas much less stable than similar clearings in the oak–tulip, poplar–birch–maple forest of Pennsylvania, even when on projecting hillsides.

It is almost certain that proper investigation will uncover *H. metea* in most of Pennsylvania's counties, and perhaps extend its known range elsewhere as well.

Atrytonopsis hianna (Scudder)

The situation concerning published records of this species for Pennsylvania is analogous to the preceding, the only citation other than Williams in Tietz (1953) being my own (Shapiro, 1963). So far *hianna* has been found in Philadelphia and Chester counties, Pa., and Burlington and Ocean counties, N. J. Further searching will undoubtedly extend its known range in the area considerably.

Forbes (1960) mentions that this and the preceding species occur together; Franklin H. Chermock and George Ehle have mentioned the same fact to me *in litt.*, referring to Maryland and Lancaster counties, Pa., respectively. Such indeed is the case. The association of *hianna* with *Andropogon* is quite clear, and generally one may find either where the other is known to occur. Generally, *hianna* is much rarer than *metea*, the numbers running in the ratio of from 1 : 5 to 1 : 20 in various colonies.

The general behavior of the two species is similar, but on the whole *hianna* is a much more active and aggressive insect. Males are especially fond of flying up and down exposed rock surfaces in the sunshine, and when such surfaces are available, will take up their territorial vigil on projecting tufts of grass or other vegetation extending from cracks in the

surface. Otherwise, they will perch on or near the ground like *metea,* darting up to chase one another with great vigor. Where the species is at all common, the males are occupied in chasing one another for much of the day; this behavior is relaxed only in the early morning and late afternoon, when both sexes are feeding. Males returning from chases are apt to be assaulted again before reaching their original perch, and other males may move in to occupy it, so that there is a constant competition for resting sites, much more intense than in *metea,* even though the species is less abundant. The chase flights are no more sustained than in *metea,* except as renewed by new challengers, but the combatants rise much higher, sometimes escaping from sight. All of this behavior is exactly similar to that of *A. vierecki* (Skinner) as I have observed it in the *Fallugia* arroyos of Bernalillo County, New Mexico.

Female *hianna* fly low, generally at six to eight inches above the ground; they have not been seen ovipositing, nor has the mating process been observed, but pairs in copula have been seen between 11:00 A.M. and 2:00 P.M., indicating that, as in *metea,* copulation probably occurs early in the territorial part of the day.

A. hianna is less active than *metea* in cool or cloudy weather, the females again flying much more than the males under such conditions. Both sexes visit flowers more consistently than *metea,* but like *metea* show a definite preference for *Rubus, Fragaria,* and *Trifolium pratense.* Unlike *metea,* it feeds regularly in the late afternoon as well as in the morning.

Male *hianna* at rest hold the wings closed, as a rule, but both sexes open them somewhat while feeding. Despite its pugnacity, the species is no more wary than *metea,* and although a startled male will depart with a fast flight high into the air, it will, if not engaged in chase by another individual, return to its original perch in a few minutes. Females never seem to become agitated to the degree that the males do, and even when alarmed make a steady and erratic flight only a foot or so above the ground.

A. hianna appears just as *metea* is disappearing, the first males about May 27, the first females about June 1, both sexes declining by June 10, with a few worn females still alive in early July. This flight period is about as limited as that of *metea,* and likewise contributes to its having remained unknown for over 100 years in a center of entomological activity like Philadelphia. The insects wander a good deal more than *metea,* but still are quite local, and could very easily be overlooked by anyone not specifically searching for them.

I have not had the time during the flight period of *hianna* to check all of the *metea* sites for this species, but those thus far examined have

demonstrated the association of the two insects, and it is to be expected that this will be the rule throughout most of the range. It certainly holds around Philadelphia, on the serpentine barrens, and in the New Jersey pine barrens.

I have not had the opportunity to investigate the early stages of either species. This may be possible in the future. Hopefully these preliminary notes will enable many more field workers to become acquainted with *metea* and *hianna* and extend our knowledge of them.

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A RECENT RANGE EXTENSION OF *PIERIS BECKERI* (PIERIDAE) IN WYOMING

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The years 1963 and 1964 have yielded very many interesting specimens in our study of Wyoming Rhopalocera, but perhaps the most unusual record has been the capture of two *Pieris beckeri* Edwards, one of each sex, in Douglas, Wyoming.

Holland (1931) states that the range of *P. beckeri* is from "Oregon to central California and eastward to Colorado." In 1937, Cross in "Butterflies of Colorado," and in 1956, Brown in "Colorado Butterflies," said that *P. beckeri* was found west of the Continental Divide. However, in 1962, Hovanitz revised the eastern limits to be the "Rocky Mountain system in Montana, Wyoming, and Colorado." His map indicates three localities in Wyoming in which *P. beckeri* had been collected: (1) the vicinity of Highway 430, south of Rock Springs in Sweetwater County; (2) the vicinity of Mammoth Hot Springs in Yellowstone National Park, and; (3) the vicinity of Cody, Park County. The locality near Highway 430 is west of the Continental Divide. Cody and Mammoth Hot Springs are both east of the Continental Divide, and are in or near mountain ranges and are within Hovanitz' new eastern limits.

Douglas, Wyoming, where our two specimens were collected, is approximately 100 miles from the Continental Divide, which at its nearest point, passes near Lamont and the Seminole Mountains in Carbon County. The Laramie Mountains, a northern extension of the Front Range in Colorado, lie about 40 miles to the southwest. Douglas is located on the western edge of the Great Plains and is in the Upper Sonoran Life Zone. The terrain is similar to the semiarid, hot, shrubby hillsides described by F. Martin Brown in "Colorado Butterflies," but Douglas is well out of the limits set by either Brown or Hovanitz.

Both specimens were captured at Douglas at an elevation of 4,900 feet. A male was captured on June 25, 1963 and a female on July 30, 1964. Both were in near perfect condition and showed no signs of travel. No difference between these and more western specimens can be noted. The late date of the capture in 1964 may have been due to heavy snows in April and May, which delayed the entire collecting season.

In California, Powell (1957) recorded the foodplant *Stanleya pinnata* (Pursh.) (Cruciferae) in addition to the previously recorded *Isomeris arborea* Nutt. (Capparidaceae) and *Brassica nigra* (L.) (Cruciferae). *S. pinnata* is widely distributed in Wyoming and *B. nigra* is found sparingly. Due to the excellent condition of the specimens and the presence of the foodplant, there seems to be no practical reason why a local brood should not exist.

The authors would appreciate hearing about any other records of *P. beckeri* east of the Continental Divide and a description of the terrain in which the specimens were captured. The records should help to determine more accurately the eastern limits of *P. beckeri* which seem to be rather uncertain.

We wish to thank Mr. F. Martin Brown and Mr. Frank Chermock who checked our determination and Dr. Jerry A. Powell, who offered help in writing the manuscript.

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A MIGRATION OF *LIBYTHEANA* AND *KRICOGONIA* IN SOUTHERN TEXAS

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During a summer vacation collecting trip in 1963 my family and I observed a migration of *Libytheana bachmanii larvata* (Strecker) and *Kricogonia* (both *castalia* (Fabricius) and *lyside* (Godart)) as we traveled through southern Texas.

We first encountered them in the late afternoon of July 4 on the western outskirts of Catarina (Dimmit County) and stopped to observe and collect. The flight here was sparse, their combined density being only about three per minute over a 100-foot front. The *Libytheana* seemed about as numerous as the *Kricogonia* (presumably both species together), but the *Kricogonia* were flying about two to three feet above the level surface of the field, while the *Libytheana* were only about half that. They were all headed approximately north, flying at an estimated rate of about eight to ten feet per second. Two *Kricogonia* were taken (1 ♂, 1 ♀, both *castalia*) and a single *Libytheana*. We left at sunset, after about one and a half hours, and the flight was still in progress.

The next morning about 27 miles south of Catarina (in northern Webb County) we again observed the migrants. Shortly after 8:00 A.M. they began to fly along with other butterflies, but at first their behavior showed no sign of migratory activity, being only conventional random movement. About 10:00 A.M. they started to migrate, the flight sparse as before, but now directed almost northeast (30° east of magnetic north, or about 39° east of true north). We collected: *K. lyside* (2 ♀), *L. bachmanii* (5).

As we continued south on U. S. highway 83 the migration increased markedly in density. At 27 miles north of Laredo (Webb County) they were passing at an estimated combined rate of about 60 per minute on a 100-foot front, at about the same speed and height above ground as before. At 18 miles north of Laredo a single male *K. castalia* was taken.

About 12 miles south of Laredo we noticed that the migration had become comprised chiefly of *Libytheana*; and about seven miles west of Zapata (Zapata County) signs of migration ceased.

On the next day, July 6, the whole morning was spent collecting on the edge of Falcon Reservoir about eight miles south of Zapata. The migrant species were all present (collected: *K. lyside* (1 ♂), *K. castalia* (1 ♂), *L. bachmanii* (10)), the *Kricogonia* few, the *Libytheana* in large

numbers. No evidence of migratory activity was seen. *Libytheana* were particularly prevalent on a low, white-flowered, heathlike plant growing in large clumps in open areas and could be seen there by the dozen.

Taking into account the direction of our route and the observed direction of the flight one may conclude that the migratory flight was in a band about 60 miles wide. Assuming an average density of 10 individuals per minute per 100 feet of front, the total rate of passage comes to about 190,000 per hour or 1.7 million per nine-hour day.

Curiously, several days later and about a hundred miles to the east—specifically on July 10 at the junction of U. S. highway 281 and Texas highway 141 (about 14 miles west of Kingsville, in Jim Wells County)—we again encountered a heavy migration of *Libytheana* (only), this time heading about due south. Our route took us north on 281 and we quickly left the migrants behind, but during the short time we were among them the car radiator became completely clogged.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Notice of proposed use of plenary powers in certain cases (A. (n.s.) 70)

In accordance with a decision of the 13th International Congress of Zoology, 1948, public notice is hereby given of the possible use by the International Commission on Zoological Nomenclature of its plenary powers in connection with the following case, full details of which will be found in Bulletin of Zoological Nomenclature, Vol. 22, Part 3, published on 13 August 1965.

(2) Designation of a type-species for *Anthanassa* Scudder, 1875 (Insecta, Lepidoptera) Z.N.(S.) 1697;

Any zoologist who wishes to comment on the above case should do so in writing, and in duplicate, as soon as possible, and in any case before 13 February 1966. Each comment should bear the reference number of the case in question. Comments received early enough will be published in the *Bulletin of Zoological Nomenclature*. Those received too late for publication will, if received before 13 February 1966, be brought to the attention of the Commission at the time of commencement of voting.

All communication on the above subject should be addressed as follows: The Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W.7, England.

W. E. CHINA

Assistant Secretary to the International Commission on Zoological Nomenclature

BOOK REVIEW

BUTTERFLIES AND MOTHS, A Guide to the more common American species. By Robert T. Mitchell and Herbert S. Zim. Golden Press, New York, 1964; 160 pp., with 423 text illustrations in color. Paper, $1.00; cloth, $3.95.

Nearly 400 species of North American Lepidoptera are treated and illustrated in this little book, another in the Golden Nature Guide series. The illustrations, which are reproduced from paintings by Andre Durenceau, are nearly all superb, making this without a doubt the finest introductory publication on American butterflies and moths available. The authors, Mr. Robert T. Mitchell, a wildlife biologist at the Patuxent Wildlife Research Center, Laurel, Maryland, and Dr. Herbert S. Zim, supervising editor and co-author of the Golden Nature Guide series, received technical assistance from authorities at the U. S. National Museum, including Capps, Clarke, Field, and Todd.

Some 180 species of butterflies and about 170 species of larger moths are treated in addition to a small number of the micros. Illustrations of the smaller moths are reproduced from the 1952 Yearbook of Agriculture "Insects" and do not approach the excellence of Mr. Durenceau's figures. Although the book is intended as an introduction for beginners or persons interested in general nature study, the large number of moths and figures of larvae and pupae, which are given for many species, together with the pocket-sized convenience of the book, will make it attractive to many experienced lepidopterists as well. The hard bound version has been slightly enlarged photographically to 5″ × 7½″ and a bit of the excellence of the color has been lost from some pages in the process.

Introductory sections include discussion of classification of Lepidoptera; eggs, larvae, pupae, and adults; techniques of collecting, mounting, rearing, etc. The treatment of species follows, in the sequence of the McDunnough checklist, with the adult shown in color for each species. Often the larva, dimorphic sexes, or underside are also illustrated. The common name and a brief discussion of pertinent features of the distribution, flight period, and foodplants are included. Indexed lists of scientific names (but not authors) and common names terminate the volume. A surprising proportion of the fauna is covered, for some groups more than one third of the known species (e.g., Papilionidae, Pieridae, Lycaenidae, Sphingidae, Saturniidae).

For nearly two-thirds of those treated, a distribution map of a generalized range of the species in North America is also given. Most of these are quite useful since they give a quick, rough idea of the species' geo-

graphical distribution. Some are a little misleading, particularly to readers interested in distributions in the western states, usually because the ranges are too restricted (e.g., *Limenitis lorquini, Lycaena rubidus, Philotes sonorensis* and *battoides, Coloradia pandora, Halisidota maculata*); a few are severely restricted (e.g., *Smerinthus cerisyi, Antheraea polyphemus, Estigmene acrea, Alsophila pometaria, Paleacrita vernata*).

In general all aspects of the treatment appear to be quite accurate. One inexcusable point is the mention of the "suborders" Jugatae, Frenatae, and Rhopalocera, thus perpetuating for beginning students the old classification which has not been used by serious lepidopterists in 20 years. One species may be figured under the wrong name. A moth which appears to be *Hemileuca* (*Pseudohazis*) *washingtonensis* Medlar is shown in an excellent figure but called *P. eglanterina*. Its distribution map appears to fit the latter species or a combination of the two if they were considered subspecies. In general, subspecies are not treated in the book. In the list of scientific names an annoying number of misspellings occur in the butterflies (e.g., *Papilio machaon aliaska, P. eurymedom, Appias drusilla neumoezenii, Speyeria nevandensis, Limenitis weidemeyrii, Incisallia*). The moth names include very few errors (e.g., *Automaris, Pseudaletia unipunctata*).

The editors of the Golden Press and the authors are to be congratulated on having produced an introductory book on butterflies and moths with accurate illustrations, at a price appropriate to the audience. Publications of this nature have long been available in many parts of the world, such as in Japan, but nothing comparable to the Golden Nature Guide *Butterflies and Moths* has been available for recommending to the beginning student in North America.

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THE MONARCH BUTTERFLY AND MIMICRY

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The theory of mimicry and the theory of warning coloration seem to generate more illogical reasoning and more ill-conceived and ill-executed experiments than any other evolutionary subject. Bruce Petersen in a recent issue of this *Journal* (1964) has not only given an uncritical account of Urquhart's arguments against the theories of mimicry and warning coloration, but has given also an account of an experiment which because of its design adds no light to the situation.

Before considering the experiment reported by Petersen it is necessary to consider the validity of a number of the objections to the theory of mimicry as presented in his paper. No one could take exception to the comment that some resemblance between model and mimic has to appear before the mimicry can be improved—this is part of the standard theory of mimicry (Carpenter & Ford, 1933: 161–168; Sheppard, 1960). Nor can one object to the statement that the food habits of captive animals may be suspect. However, there is grave objection to the statement that stomach analysis of wild animals is the best evidence of their food perference. This unsupported statement presupposes that the remains of all animals are equally likely to be detectable in the stomach. In fact observation of predators in the wild is far better evidence as is shown by the work of Kettlewell (1956) and of Tinbergen (1960) to mention only two workers in the field. Also the statement that no butterfly predator has been suggested as the evolutionary force responsible for mimicry is untrue, both birds and lizards have been so considered.

One of the most amazing arguments against mimicry which Petersen uses is: "Birds frequently eat caterpillars (which show no mimicry) and rarely eat butterflies (which supposedly mimic each other frequently). If natural selection were responsible for mimicry one would expect to find it in caterpillars—not butterflies." It is perfectly true that birds frequently eat some kinds of caterpillars, one cannot just say "eat caterpillars"—it depends which caterpillars they are (for example they do not readily eat the larvae of *Pseudosphinx tetrio* (L.) or *Hipocrita jacobaeae* (L.), and more rarely eat butterflies. But the argument that if natural selection were responsible for mimicry one would expect to find it in caterpillars not butterflies is a nonsequitur. Birds are known frequently to eat moths, but you don't find mimicry here either except in some day flying ones. One would only expect mimicry to evolve in species which by their daytime activities are already fairly conspicuous. One would not expect it to evolve in

animals which are highly cryptic and can remain almost motionless during the day. The statement that mimicry has not been found in caterpillars is completely unsubstantiated by him. However, most of the known cases of larval mimicry (except perhaps the snake mimics) are probably Müllerian, not Batesian. Since they can remain still during the day, most edible caterpillars are highly cryptic, it being a more effective mode of protection for them then Batesian mimicry would be. In fact mimicry theory predicts that Batesian mimicry will be very rare among animals which are chiefly nocturnal such as moths and caterpillars. This is supported by the observation that both warning coloration and mimicry are not uncommon in day flying moths but both are rare in night flying ones, mimicry being excessively so.

The statement that "even very distasteful creatures are better off to be inconspicuous than to be brightly coloured" is just false and has been shown to be so on many occasions. For a recent example see Sheppard (1964). Also the fact that 50 people did not find the monarch butterfly objectionable is no argument against the theory of warning coloration or mimicry since man has never been postulated to be the predator responsible for this mimicry. The scarlet tiger moth *Panaxia dominula* (L.) is not unpalatable to the many people who have tried it, but is one of the most distasteful British moths to many of its natural predators, as is shown not only by experiments with captive animals (Rothschild, 1961a, 1961b, Rothschild & Lane, 1960), but also by experiments on wild birds in a garden (Sheppard, 1964). The statement that "only in Dr. Brower's work is there any indication that birds dislike monarch butterflies," is untrue (see Jones, 1932, 1934).

Again the objection that birds are almost never seen feeding on monarch butterflies is not a valid one. Birds are almost never seen feeding on the peppered moth *Biston betularia* (L.) and yet predation by birds has been shown to be responsible for the development of industrial melanism, and often acts at the rate of up to 15 to 50% of them being taken per day (Kettlewell, 1956). The fact that monarchs marked for migration experiments have been eaten in large numbers apparently because their appearance has been altered (Urquhart, 1957) is in complete accord with the theory of mimicry. One might expect an alteration of the wing pattern to cause the individual to be attacked; in fact the statement indicates that butterflies can often be attacked by birds.

If one accepts the suggestion that the tagged monarchs were eaten because their appearance had been altered and that the normal pattern does not elicit a feeding response, then the requirements for the evolution of mimicry are satisfied, regardless of whether the model is distasteful or not. Clearly it would be an advantage to the viceroy to be mistaken

for any animal that isn't eaten; this would be true mimicry. However, there is no evidence contrary to the view that the reason for the tagged monarchs being eaten is that they were no longer recognized as distasteful models.

Mimicry theory does not fail "to explain why the banded purple doesn't mimic the monarch, as it is the same genus as the viceroy." If mimicry is effective one would expect it to mimic some other model and be much less likely to mimic that utilized by its close relative, since the advantage of mimicry wanes as mimetic pattern becomes commoner. In fact a closely related species[1] to the banded purple, the red spotted purple *Limenitis astyanax* (Fabr.), is a mimic, not of the monarch, but of the pipe vine swallowtail *Battus philenor* (L.).

The experiments reported by Petersen are no more informative or valid than his theoretical arguments. The experiments do not seem to have been designed at all. There is absolutely no control, nor apparently has any record been taken of which birds took what. It would have been perfectly possible for the monarch to have been lethal to every bird that ate it, and still the results given in the graph could be true ones. To show that the monarch is or is not distasteful requires a much more subtle experiment. To begin with distatefulness is only relative, so that one has to have some comparison—the best comparison of course would be butterflies of about the same size, but with a different wing pattern, which are believed for other reasons to be edible. The fact that the wings were cut off so that the insects were not recognizable as models, they in fact were mimicking "elongated, jumping, black spiders with tetany," would mean that the birds might not learn to avoid them at all, if they were normally feeding on black spiders.[2] This would be in accord with the theory of mimicry. Winged and wingless monarchs were not given on alternate days or days picked at random, nor do we know how many birds were feeding on them. The data on the winged individuals is certainly far too scanty for one to determine whether any of the birds were gradually learning to avoid them. The only thing the experiment does do is to show that Urquhart's contention that the monarch does not elicit a feeding response is untrue since a proportion of the winged ones given in December were apparently eaten, although the data do not show how many of the ones not eaten were pecked at then rejected. Nor is the data as presented (graph 1) in agreement with the statement "the last one to be eaten had been lying dead on the patio for four days. A day-by-day tabulation of the butterflies

[1] The present author does not agree with the treatment of *L. astyanax* as a separate species in the recent dos Passos List and believes that all evidence indicates *astyanax* and *arthemis* are subspecies.

[2] See also: Parsons, J. A., 1965. A digitalis like toxin in The Monarch, *Danaus plexippus*. Jour. Physiol., 178: 290–304.

is presented in graph 1"! The last seven to be eaten appear to have been put out and eaten on the 2nd of January.

Incidentally, the implied idea that the results from birds feeding at a feeding station, where they were used to finding quantities of food, is somehow more natural and therefore more valid than Dr. Brower's experiments is highly questionable. So also is the statement that the birds "could have lived off a bounteous Iowa summer, or the food in the bird feeders." The idea that when birds are raising nestlings there is always an abundance of food is refuted by a great deal of ecological work, (for example see Lack, 1954).

Both the objections to the theory of mimicry and warning coloration and the experiments presented by Petersen (1964) are not of the sort which would allow one to arrive at a competent conclusion on the validity of the theories.

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SOME BUTTERFLIES OF THE PINOS ALTOS MOUNTAINS, NEW MEXICO

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The Pinos Altos Mountains lie just north of Silver City in Grant County, New Mexico. This range is of rather small extent and has maximum elevations of just over 9,000 feet. On north-facing slopes at higher elevations there are forests of Douglas fir (*Pseudotsuga taxifolia*), limber pine (*Pinus flexilis*), quaking aspen (*Populus tremuloides*), New Mexico locust (*Robinia neo-mexicana*), and mountain maple (*Acer glabrum*). A more xeric forest is also present and is composed mainly of ponderosa pine (*Pinus ponderosa*) and Gambel oak (*Quercus gambelii*). Evergreen woodland occurs at lower elevations and consists mainly of pinyon (*Pinus edulis*), junipers (*Juniperus deppeana* and *J. monosperma*), and live oaks (*Quercus hypoleucoides, Q. emoryi,* and *Q. grisea* and/or *arizonica*). Chaparral is composed of such plants as mountain mahogany (*Cercocarpus* sp.), squawbush (*Rhus trilobata*), buckbrush (*Ceanothus greggii*), silk tassel (*Garrya* sp.), manzanita (*Arctostaphylos* sp.), bear grass (*Nolina microcarpa*), and scrub oak (*Quercus turbinella*). Streamside vegetation of middle and lower elevations in these mountains is dominated by Arizona alder (*Alnus oblongifolia*), narrow-leaved cottonwood (*Populus angustifolia*), box elder (*Acer negundo*), Arizona walnut (*Juglans major*), and willows (*Salix* spp.).

Collecting was done in this area in the years 1957 through 1959 and was concentrated in the canyon of Cherry Creek. All of the previously mentioned habitats are present in some degree in or near this canyon. No species of butterflies which were found elsewhere in this range were absent from this particular site, although several which occurred here were not found elsewhere.

In the following list, species are grouped on the basis of their abundance in suitable habitat and at the proper season. Doubtless some species were under-collected and with further study would be found to be more common. All species records listed here are based on collected specimens with the exception of the Monarch (*Danaus plexippus*), and include only true butterflies (a short list of skippers will be presented at a later date). I wish to thank Messrs. L. P. Grey, Fred Thorne, and Raymond Jae for their help in the identification of certain species.

I. Common to abundant.

Papilio multicaudata Kirby
Eurema mexicana (Boisduval)
Strymon melinus Hübner
Callophrys apama (Edwards)
Celastrina argiolus (Linnaeus)
Phyciodes mylitta (Edwards)
Melitaea minuta Edwards
Speyeria atlantis nausicaa (Edwards)

II. Uncommon to fairly common.

Battus philenor (Linnaeus)
Papilio rutulus Lucas
Neophasia menapia (Felder & Felder)
Pieris sisymbrii Boisduval
P. protodice Boisduval & LeConte
Colias eurytheme Boisduval
C. cesonia (Stoll)
Phoebis sennae (Linnaeus)
Eurema nicippe (Cramer)
Nathalis iole Boisduval
Limenitis bredowii (Geyer)
Nymphalis californica (Boisduval)
N. antiopa (Linnaeus)
Polygonia zephyrus (Edwards)
Chlosyne lacinia (Geyer)
Phyciodes texana (Edwards)
Anthocaris sara Lucas
Apodemia nais (Edwards)
Hypaurotis crysalus (Edwards)
Mitoura siva (Edwards)
Erora quaderna (Hewitson)
Leptotes marina (Reakirt)
Plebejus acmon (Westwood & Hewitson)
Libytheana bachmanii (Kirtland)
Limenitis astyanax (Fabricius)
L. weidemeyerii Edwards
Euptoieta claudia (Cramer)
Danaus gilippus (Cramer)
Euptychia dorothea (Nabokov)
E. rubricata Edwards
Gyrocheilus patrobas (Hewitson)

III. Rare.

Papilio polyxenes asterius Stoll
P. ?bairdii Edwards
Colias philodice Godart
Strymon leda (Edwards)
Hemiargus isola (Reakirt)
Everes comyntas (Godart)
Glaucopsyche lygdamus (Doubleday)
Vanessa atalanta (Linnaeus)
V. virginiensis (Drury)
V. cardui (Linnaeus)
Melitaea fulvia Edwards
Agraulis vanillae (Linnaeus)
Danaus plexippus (Linnaeus)

Such species as *Cercyonis sthenele* (Boisduval), *Pieris napi* (Linnaeus), and *Colias alexandra* Edwards were not found in this mountain range during the course of this study, although they are common in the nearby Mogollon Mountains. Their absence may be correlated with the fact that the Mogollons are higher, more extensive, and more mesic than the Pinos Altos Mountains.

In summary, 52 species of butterflies of the superfamily Papilionoidea were recorded in the low, forested Pinos Altos Mountains in southwestern New Mexico in three years of collecting.

ADDITIONAL NOTES ON REARING AND PRESERVING LARVAE OF MACROLEPIDOPTERA

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Since my earlier paper on this topic was published in this *Journal* (Vol. 18, no. 4: pp. 201–210), a number of miscellaneous details have accumulated and are brought together here under the appropriate headings. This paper is intended as a supplement to the earlier paper.

Rearing

Feeding confined adult Lepidoptera while awaiting oviposition: Mr. H. Simmonds an entomologist in Suva, Viti Levu, Fiji, has developed a very useful, long-lasting medium (Honey-Agar) which is prepared as follows: (1) Dissolve 6–8 grams of agar-agar in 200 cc of water. (2) Add 250 to 320 cc of honey, and bring to a boil. (3) Pour out into a shallow plastic box or petri dish, and let cool. Store in refrigerator.

Use small pieces of honey-agar as needed for feeding confined Lepidoptera. A small amount of water may be placed on the piece to liquify its surface slightly, if this appears to be necessary. This substance may then be placed in the cage or jar with the confined insect, where it will serve as a food supply for many days. A small amount of water should be provided in another container nearby, but must be kept in such a way that the insect cannot fall into it or get its wings wet. Mr. B. O'Conner, Principal Entomologist at Koronivia Research Station, Nausori, Viti Levu, Fiji, told me that a slight modification of the above mixture, using 8 grams of agar-agar in 50 cc of water, with 300 cc of honey, seems to be more mould-resistent. In any event, the honey-agar method (or modifications of it) has obvious advantages over any method that requires the use of a wet or sticky solution needing to be frequently replaced. Difficulties with mould are also minimized.

Keeping newly hatched larvae alive until a suitable foodplant is located: Mr. N. B. Tindale of the South Australian Museum, Adelaide, informs me that the following technique will save many small larvae for an additional few days, which may make all the difference in getting them started, when it is not possible to locate the foodplant immediately. Place a piece of cut apple in a small box with the newly hatched larvae. Recut a thin slice off the cut surface each day, so that the surface continues to give off moisture. This slows down desiccation of the small larvae, and at the same time, they will often nibble at the cut surface of the apple, thus obtaining some nourishment.

Larvae requiring sunlight for stimulation of feeding should be provided

with it every day if possible; electric light is only a second choice, and will not produce such good results (in as short a time) as will a little daily sunlight. However, if electric light must be resorted to, be certain not to use the "cool white" (daylight) fluorescent tubes. "Warm white" fluorescent tubes are very satisfactory, however. Incandescent bulbs are also satisfactory, but one must beware of overheating the larvae if they are employed.

Pupae in diapause: Certain fall or winter-emerging moths need exposure to gradually LOWERING temperatures prior to emergence. This is just the reverse requirement of those emerging in spring or summer, but again, outdoor conditions are definitely preferable to any artificially produced conditions indoors, particularly about the time of emergence.

Most pupae in diapause come through to emergence time in excellent condition if kept in empty (no soil, sand, or moss), clean, glass jars of small size, with tight-fitting lids without holes. Cheesecloth strips may be provided for any unexpected emergences.

Preserving

Further details on the preserving technique: It is well to have a SEPARATE jar for the killing-jar (into which the larva is first dropped), as the solution in it will rapidly become too cloudy for use in preservation, yet it will serve indefinitely for killing. This procedure will save preserving fluid to an appreciable extent.

After the larva has been injected and replaced in the preservation-jar containing the solution, it should lie on its side until such time as it is to be removed to 95% ethyl alcohol for "clean-up" and permanent storage.

Exceptions to the general rule of injecting larvae should be observed for all lycaenid larvae, and also for most geometrid larvae of small to medium size. Such larvae are simply killed and left in the preserving solution without being injected, and then are removed to 95% ethyl alcohol after sufficient time in the preserving solution.

Larvae feeding on *Quercus* (any oaks) or certain leguminous plants sometimes need to be starved for a day to give best results in preservation. Otherwise, internal discoloration (darkening) may occur even after injection. This is not usually the case, but it happens often enough to warrant mention. These remarks also apply to many skipper larvae.

Preservation of eggs: As the inner tissues of eggs pull away from the outer covering, in most solutions, Peterson (1960: *Florida Entomologist*, 43 (1): 1–7), recommends the use of "a standard K.A.A. mixture diluted four or five times with ethyl or isopropyl alcohol. A standard K.A.A. mixture consists of 1 part commercial kerosene, 2 parts acetic acid, and 10 parts ethyl or isopropyl alcohol. For many eggs, isopropyl alcohol in the K.A.A. solution produces the most satisfactory results." But, as Peter-

son states, bright colors, waxy coatings, and other surface characteristics of some eggs are apt to change upon standing in liquid preservatives.

The eggs can be stored in vials of 95% ethyl alcohol, once they have gone through a preservation solution, but changes may occur in some eggs; others will remain in rather good condition, and still others may show external or internal features that are not so readily seen in the living eggs. If possible, it is worthwhile to either photograph, draw, or describe the eggs several days before the day they hatch. At the same time, note color changes as the eggs age.

Preserving solution: As dioxane is highly toxic, it is advisable to use a preserving solution which omits it, or which contains only a very small amount of it (such as K.A.A.D.I.). J. S. Buckett, of Davis, California recently produced a preserving solution that totally omits dioxane, but gives excellent results which are comparable to K.A.A.D.I., or perhaps even better. This solution ("K.A.S.A.") is as follows:

Kerosene (as obtained at service stations)—3 parts ±
95% Ethyl Alcohol—9 parts
sec—butyl Alcohol, CH_3 CH_2 $CH(OH)$ CH_3—5 parts ± (enough to "clear" the solution and make the kerosene miscible)
Glacial Acetic Acid—2 parts

In K.A.S.A., and in the other solutions given in the previous paper, the sec-butyl alcohol, iso-butyl alcohol ($(CH_3)_2$ $CHCH_2$ OH), or dioxane (depending upon the solution) must be varied slightly in quantity, its function being to "clear" the solution so that it is water-clear and no kerosene is on top. For example, if exactly five parts of sec-butyl alcohol do not totally clear the solution of K.A.S.A., keep adding small additional amounts (and stirring) until it becomes clear. All of these solutions should be used only under conditions of adequate ventilation. Contact with the skin by solutions should be avoided as much as possible.

Briefly, the functions of the components of the various preserving solutions are as follows: the kerosene causes inflation of the specimens. The dioxane (or, the iso-butyl or sec-butyl alcohol) makes the kerosene miscible in the rest of the solution, and so must be increased or decreased along with variation in the amount of kerosene used. The acetic acid helps prevent internal darkening or discoloration of specimens. In standard K.A.A.D., the amount of alcohol used can vary between 7–10 parts, and the dioxane can be replaced with sec-butyl or iso-butyl alcohol, but more than one part is needed when using one of these substitutes. K.A.S.A. appears to be the best of the solutions I have used so far, and it is easily prepared; also, it has the additional good feature that it contains no dioxane.

All of these solutions seem to work better when slightly dilute with larval fluids (*i.e.*, when light yellow-green in color); the fresh solution

used to replace old solution in the preservation-jar is often improved by adding to it a small amount of the old solution. Fats and oils that float on top of used solution are easily blotted up with a rolled piece of Kleenex or paper towel, and this should be done periodically.

Injection of pupae is usually a simple procedure but the following points should be kept in mind: Pupae should never be injected and preserved until they are at least several days old, and are thoroughly hardened. Injection should be in the abdominal region, between the segments, and it is sometimes desirable to inject through several different places in one pupa; this is particularly necessary with nymphalid pupae, which will often turn pinkish or red if not sufficiently injected with preservative. In the case of very soft pupae, or those in which the wing cases tend to break away somewhat after injection (some lycaenids and small geometrids, etc.), one light injection in the abdominal region is ample, and they should not be left more than a few hours in the preservative before being removed to 95% ethyl alcohol; in some cases, a few minutes is sufficient time in the preservative. If the wing cases collapse in a soft pupa, the pupa should be injected again upon REMOVAL from the preservation-jar, this time using 95% ethyl alcohol; then place it in 95% ethyl alcohol for permanent storage (after a period of soaking in the "clean-up jar," as described in the earlier paper).

Stoppers and vials: The size-numbering system for neoprene stoppers is not the same as that used for standard cork stoppers. The following sizes of neoprene stoppers fit the sizes of vials given in parentheses: No. 00 stopper (1 and 2 dram homeopathic vials); No. 1 (4, 6, and 8 dram homeopathic vials); No. 3 (6 dram shell vial); No. 4 (8 dram shell vial). The stoppers should fit tightly, needing to be twisted in while letting out the trapped air with a bent insect pin. Neoprene stoppers come in various colors, including gray.

Both the "long form" and the "short form" of the eight dram homeopathic vial are useful; although the former is difficult to obtain, it is just right for storing many sphingid larvae or other long larvae that will not quite fit into the usual (short form) eight dram vial. For very large larvae, it is necessary to use olive bottles or similar containers. To save metal screw-caps, thin sheet polyethylene can be placed over the bottle top before screwing on the cap.

The various flexible plastic "push-in" or "snap-on" caps for vials are not as satisfactory as neoprene stoppers in the prevention of evaporation over long periods. Furthermore, neoprene stoppers will not harden in the way that some plastic caps will, and the neoprene stoppers can always be forced back in tightly after removal from vials. It is possible to write directly on neoprene stoppers, using permanent ink, which is a convenience.

DESCRIPTION AND HABITS OF LARVAE OF *ANNAPHILA PSEUDOASTROLOGA* (NOCTUIDAE)

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The following descriptions are based on 60 larvae reared from ova laid by three females collected during March, 1953, and March and April, 1955, in La Tuna Canyon, Verdugo Mountains, Los Angeles County, California.

Although the manuscript was completed in 1957, it seemed advisable to postpone submitting it until after Frank Sala had published information about his discovery, a few years earlier, of the habits of two closely related species of *Annaphila*, one of which was *astrologa* B. & McD. These two species fed on different plant species growing in the same area of the Santa Monica Mountains, Los Angeles County, California. In his revision of the *astrologa* group, Mr. Sala (1964) has clarified the status of the several species involved. The species which I reared matches the description of the newly described *pseudoastrologa* Sala.

In confinement, females of *A. pseudoastrologa* oviposited only on leaves of *Phacelia minor* (Harvey) Macbr., although several other species of native annual plants were also offered them.

Newly hatched larvae fed readily on leaves, flowers, and unopened buds; a few entered buds, through holes chewed in the corollas, and remained hidden inside; while others fed externally on the buds. There is no variation in the actual pigmentation of various individual larvae in the first and second instars; however, because of their translucency, some appear to be greenish and others of a purplish tint, depending on whether they have eaten leaves or blossoms. After the second molt, the larvae acquire the pattern and coloring which is maintained throughout the third, fourth, and fifth instars with only slight changes in shade and maculation. In these last three instars larvae are extremely variable, hardly any two individuals being alike.

Second Instar: Length 7 mm. Body translucent, cream-colored with fine white middorsal and subdorsal lines extending entire length. As in first, third, and fourth instars, the first two pairs of prolegs are smaller than others.

Third Instar: Length 11 mm. Pattern and coloring same as in following instar.

Fourth Instar:

Larva no. 1. Length 20 mm. Narrow white middorsal and subdorsal lines extending entire length of body, consisting of numerous minute specks of varying sizes and shapes, some confluent, others not quite touching each other; these specks never confluent for more than one-third the length of a segment. Ground color gray-green, cervical shield lighter. Thoracic segments entirely overlaid with deep purplish pink. Abdominal segments deep-purplish-pink except slightly less than one-third of the

posterior and anterior portion of each segment. A broad white subspiracular line, interrupted on the central one-third of each abdominal segment by a pink area, extending from the anterior one-third of abdominal segment I to the anterior one-third of abdominal segment VIII. Ventral surface and prolegs light green. Head light green, speckled with numerous tiny gray and brown dots; setae white. Spiracles with black centers encircled with white. Prominent white thoracic and abdominal setae arise from slightly raised white tubercles with black centers.

LARVA NO 2. Yellow-green ground color. Area between subdorsal line and spiracles dark gray-green. A trace of pale pink surrounding each spiracle. Broad greenish-yellow subspiracular line extending from anterior of second thoracic segment to posterior of abdominal segment VIII; lower edge of line very irregular. Numerous greenish-yellow specks on bases of prolegs and on ventral surface of body. Prolegs on abdominal segment IV slightly smaller than those of segments V and VI; prolegs on segment III slightly smaller than those of segment IV.

Fifth Instar: Length 29 mm. All prolegs are same size.

LARVA NO. 1. Markings and coloring same as previous instar.

LARVA NO. 2. Ground color light green changing to brownish-green during latter part of instar; body densely speckled with small yellow-green flecks and blotches except in middorsal and suprastigmatal areas. The latter unspeckled area is 1.5 mm broad; middorsal unspeckled area is 0.5 mm wide. Thoracic segments with an indistinct middorsal line consisting of a few disconnected yellow specks. From anterior edge of first abdominal segment to rear edge of seventh abdominal segment extends a broad irregular subspiracular band of yellow-green broken into a pattern of disconnected blotches on the central one-third of each segment. Area around each spiracle tinged pink.

LARVA NO. 3. Ground color dark yellow-green, speckled with light yellow-green. Deep purplish-pink stigmatal stripe approximately 1 mm wide extends from first thoracic segment to rear of spiracle on abdominal segment VIII. Spiracles set on lower edge of this stripe. More purplish-pink areas at bases of legs and prolegs, and in similar locations on abdominal segments I, II, and VII. Fine middorsal line of interrupted irregular yellowish-green specks (some confluent) extending as far as the rear of abdominal segment VIII, bordered by an irregular intermittent narrow strip of gray-green. Small white tubercles from which setae arise less conspicuous, not raised quite so much, as in previous instar. Head gray-green with numerous brown and black specks.

LARVA NO. 4. The rear margin of each abdominal segment from number I through VI deep yellow, shading to reddish in middorsal area; these yellow bands not extending beyond upper margin of the purplish suprastigmatal line. Ground color varying from light brown with green tinge to purplish-brown (the latter shade forming a middorsal band which is almost 1 mm wide). Green subspiracular line irregular and rather obscure. Yellow-green specks on rest of body arranged similarly to those of larva No. 3.

LARVA NO. 5. Entire body deep purplish-pink speckled lightly with a few minute gray flecks. Broad dark yellow substigmatal line broken into a series of dashes by dark pink area on central one-third of each segment, extending from pink area on center of second thoracic segment to pink area on center of abdominal segment VII.

Larvae form cocoons on rocks, hard clods of soil, chips of wood, pieces of bark, or dead woody stems. Fragments of wood are chewed off and fastened together to form very hard thin-walled cocoons. The hollows chewed out of the wood serve as the bases of the well camouflaged cocoons. When no woody material is available, larvae attach cocoons of soil particles to clods or rocks. Pupation occurs in late May; adults emerge the following spring.

A small series of my reared adults has been placed in the collection of the United States National Museum. A few preserved larvae are in the Yale University collection.

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THE BEGINNING OF THE BUTTERFLY SEASON

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Work on another problem has yielded a by-product that may have some interest for collectors, particularly those who may be planning trips to areas with which they are not familiar. This by-product is a rough means of estimating the beginning of the "butterfly season" in any given place.

The estimate depends heavily on two hypotheses. The first is that the yearly course of the mean temperature in a locality can be approximated closely by a simple sine function:

$$T_d = T_C + \frac{R}{2}(1 - \cos A)$$

T_d = mean temperature for day d, counted from January 1; T_C = mean temperature of coldest month (usually January in the northern hemisphere); T_H = mean temperature of hottest month (usually July in the northern hemisphere); $R = T_H - T_C$; and $A = (72/73)\ (d - b)$. In the last, b is the seasonal lag and normally is around 13.5.

The second hypothesis is less well documented: that there exists a temperature threshold above which butterflies fly, below which they do not; and which also functions as a limiting value for geographical occurrence. As applied here, the threshold refers to mean temperatures and its value has been determined to be about 43° F. (6.1° C.). In confirmation of the hypothesis it can be observed that in localities where T_H is below this value, virtually no butterflies occur; and in areas where T_C is above this value, at least some butterflies fly through the winter. Furthermore, in several places where accurate data on butterflies are available the time of the year when the mean temperature, on the average, reaches this value about marks the average time of appearance of the first butterflies (overwintering hibernators).

TABLE I. APPROXIMATE AVERAGE STARTING DATES FOR THE BUTTERFLY SEASON. IN EACH BOX THE *UPPER DATE* IS FOR APPEARANCE OF OF HIBERNATORS; THE *LOWER DATE* IS FOR THOSE EMERGING FROM OVERWINTERING PUPAE

Merriam life zone	T_H \ R	80° F. (44.4° C.)	70° (38.9°)	60° (33.3°)	50° (27.8°)	40° (22.2°)	30° (16.7°)	20° (11.1°)	10° (5.6°)	0° (0°)
Arctic–Alpine	43° F.	–	–	–	–	–	–	–	–	–
	(6.1° C.)	–	–	–	–	–	–	–	–	–
Hudsonian	50°	11 June	9 June	5 June	1 June	26 May	18 May	4 May	21 Mar.	–
	(10°)	–	–	–	–	–	–	–	–	–
Canadian	57°	26 May	24 May	18 May	12 May	4 May	19 Apr.	21 Mar.	–	–
	(13.9°)	9 June	8 June	5 June	1 June	26 May	18 May	2 May	22 Mar.	–
Transition	64°	14 May	10 May	4 May	25 Apr.	13 Apr.	21 Mar.	–	–	–
	(17.8°)	26 May	22 May	18 May	12 May	2 May	19 Apr.	22 Mar.	–	–
Upper Sonoran (U. Austral.)	72°	2 May	25 Apr.	17 Apr.	4 Apr.	19 Mar.	5 Feb.	–	–	–
	(22.2°)	12 May	7 May	30 Apr.	22 Apr.	9 Apr.	18 Mar.	–	–	–
Lower Sonoran (L. Austral.)	79°	21 Apr.	13 Apr.	2 Apr.	19 Mar.	19 Feb.	–	–	–	–
	(26.1°)	2 May	25 Apr.	17 Apr.	5 Apr.	19 Mar.	4 Feb.	–	–	–

From the above formula it is not difficult to obtain the following relation, substituting X (the threshold value, unspecified) for T_d and solving for d:

$$\text{starting date} = 13.5 + \frac{73}{36} \sin^{-1} \sqrt{\frac{X + R - T_H}{R}}$$

which gives the starting date (the date that the mean temperature reaches the threshold value X) as the number of days from the first of January.

Using a value of 43° F. for the threshold gives a date rather ahead of the time most collectors would consider significant since it indicates the time when the first hibernators appear. By taking a higher threshold value, 50° F. (10° C.), one obtains a date more nearly that when the first butterflies appear that have emerged from overwintered pupae. In the table both of these dates are given.

In order to use the table, one needs only the values of T_C and T_H for the locality in question (usually respectively mean January and mean July values). From them obtain R and enter the table with R and T_H, interpolating as necessary. The values of T_H given in the table are the defining boundary values of the Merriam Life Zones, which are added along the side. If the area for which one seeks information has no temperature data directly available for it, obtain the data for the nearest station in about the same latitude, get the difference in elevation between that station and the area of interest and adjust the values of that station by a lapse rate of 1° F. per 300 feet (1° C. per 166 meters) of elevation difference. Since both T_C and T_H lapse at about the same rate, no change in R is needed. Instead of the table, of course, the formula may be used for a direct computation.

These points should be kept in mind in using either table or formula: (1) the premise is solely for a thermally controlled flight season. Where the flight season is more under control of pluvial conditions, it does not pretend to apply. (2) The premise is solely for average conditions. In putting it to practical use, any information available on the advancement or retardation of the particular season should be taken into account. (3) Error in the dates given in the table or calculated directly is likely to be most extreme in areas approaching the threshold values for either T_H or T_C. (4) For areas where the seasonal lag is markedly more or less than 13.5, the difference should be added to or subtracted from the date obtained. Seasonal lag is a very difficult datum to get, but departure from the given lag value is rarely significantly great except (so far as I know) in the immediate vicinity of the Pacific Coast of North America. (5) Presumably, d should be counted from July 1 in the southern hemisphere.

TWO WEEKS OF BUTTERFLY HUNTING IN CENTRAL LABRADOR

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On July 5, 1964, I left for Schefferville, Quebec, in quest of arctic butterflies. The modern community of Schefferville is located nearly in the center of the huge Labrador Peninsula. It can be reached by train, which winds 360 miles from Seven Islands to the well-developed iron-mining center in the Province of Quebec. Because of the thorough report given by Eugene Munroe (1951), who collected in northern Quebec for six weeks in 1948, I was able to determine the best time for my trip and had a good idea of what to expect.

The morning of July 8, my first day, was somewhat cloudy and cool. At noon it cleared up and was sunny for the rest of the day. I decided to search for *Boloria polaris groenlandica* Skinner on a mountain ridge that afternoon and found fresh males there in considerable numbers at about 2,600 feet. Next day again I only encountered males, but on July 11, a hot day already in the morning, the first females appeared. The *polaris* flew only a few inches above the ground, mostly against the strong wind, as reported by Dr. Munroe. They were quite hard to catch, one being unable to keep sight of them while they were in flight.

On July 10, I collected in a black spruce bog and an adjacent boggy meadow, at the outskirts of the town. There, besides *Oeneis jutta ridingiana* Chermock & Chermock, five species of *Boloria* were taken flying in the boggy meadow: *Boloria selene atrocostalis* Huard, *toddi toddi* Holland, *frigga saga* Staudinger, *titania boisduvalii* Duponchel, and *eunomia triclaris* Huebner. The *eunomia* were by far the commonest. The *toddi* were all extremely dark suffused, even in the females which are of the same size as the males, or smaller. Many *toddi* and *frigga* appeared somewhat worn, indicating that these two species hatch in the first days of July.

From Schefferville a 15 mile dirt road through tundra forest leads to Lake Attikamagan in the Province of Newfoundland. There on July 15, I collected *Boloria titania* males and females, *eunomia*, one *B. freija* Thunberg male, one *Colias pelidne labradorensis* Scudder, and some *Pyrgus centaureae freija* Warren. The weather up to that time was mostly hot, the temperature did not even drop greatly at night. A rainstorm occurred late at night July 15, and next morning the thermometer showed 32° F. and a severe snowstorm developed, which lasted till noon! The next day it was sunny and warmer again, so I decided to go back to the

mountain once more. There for the first time encountered *Plebejus aquilo aquilo* Boisduval. Both sexes apparently hatching the same day. Despite the fact that these were numerous, I was able to catch but few. The tiny blues are extremely wary, approached they fly up into the strong wind and one could see them only few seconds. Most of the few I took, were netted late in the afternoon, when the butterflies sat down to rest for the night. That last day I also found *Oeneis taygete taygete* Geyer more common that they had been a few days before, when only single specimens could be seen. I also took one *Oeneis melissa assimilis* Butler, several *P. centaureae, C. pelidne*, and *B. polaris* females. Besides the *aquilo*, the *O. taygete* were also hard to approach, let alone to catch. The collector simply cannot follow butterflies over the rocks, which make use of the always present strong wind while escaping! Owing to the fact that it must have been a "hot" summer in that part of the country, the butterfly-season was more stretched out, than in 1948 when Dr. Munroe collected there. No *C. pelidne* was seen before July 15 and only three July 17. *Lycaeides argyrognomon scudderi* Edwards and *Hesperia comma borealis* Lindsey were not found. Both seemed to be the last butterflies to appear in July and were recorded by Dr. Munroe. There are 15 species of butterflies known to be breeding in the Schefferville region. Four of them: *Boloria toddi, frigga, freija*, and *Oeneis taygete* had previously not been reported from Central Labrador. *O. jutta*, was previously recorded north of Schefferville.

It was a rich, unforgettable experience, collecting in the subarctic and truly arctic life zones of Labrador. Something to consider for collectors, who dream of collecting arctic butterflies.

Literature Cited

Munroe, Eugene, 1951. Field Notes on the Butterflies of Knob Lake, Northern Quebec. Lepid. News, 5: 7–9.

EDWIN RAY HULBIRT (1886–1965)

Edwin Ray Hulbirt was born in Lovelton, Pennsylvania, April 9, 1886, and died in Glendale, California, March 12, 1965. He was the son of Franklin J. and Nora Spring Hulbirt. He received his college degrees, B.S., June, 1908, and M.A., 1909, from Princeton, where he was Phi Beta Kappa. His thesis, "Specific Charge of Ions Emitted by Hot Metals," was published in the Philosophical Magazine of London in 1910.

"Dr. Ray," as he was respectfully and affectionately known by many of his associates, had a long career as teacher, research chemist, and ad-

ministrative officer, in addition to his avocational interest in entomology, philately, music, and mountain climbing.

He engaged in chemical research at the University of California in 1916, taught physics, chemistry, and mathematics at Grant Pass High School in Oregon, 1910–1913, and was instructor in science and Vice-Principal at Citrus Union High School, Azusa, California, 1913–1920. He helped organize the Citrus Junior College, and was its first Dean, 1915–1918. His research in hydrocyanic acid led to his appointment as Chief Chemist for the Owl Fumigating Corporation at Azusa. This company was absorbed by the American Cyanimid Company, in which he served as Chief Chemist, 1920–1941, and Administrative Assistant, 1941–1947, when he retired.

His many entomological correspondents knew him as Lowell Hulbirt. This is explained by the fact that when his son Lowell developed an interest in Lepidoptera, Ray took an active exchange in his son's name. This was continued long after the son lost this interest, probably to save lengthy explanations.

Ray's love of music led to competency in the alto-horn, clarinet, and bassoon, all of which gave him and his associates great pleasure. His mountain climbing led to the ascent of Pike's Peak, 1909, Mt. Shasta, 1911, Mt. Hood, 1912, Mt. San Antonio, 1915, 1917, 1920, Mt. San Jacinto, 1918, 1924, Mt. Hoffman, 1921, Mt. San Gorgonio, 1922, Mt. Whitney, 1922, and Mammoth Peak, 1923. These early dates and heights were indicative of his exploratory daring.

He was Past Master, Azusa Masonic Lodge #905, Past High Priest, Azusa Chapter #80, and Past Master, Azusa Council #32.

He is well remembered in our entomological groups for his work in the Hesperidae and Lycaenidae. Two butterflies were named for him, *Hesperia comma hulbirti* Lindsay, 1939, and *Lycaena dorcas hulbirti* Field, 1936.

He was active in the Lepidopterists' Society, (10 years), the Western Society of Naturalists, (6 years), The Lorquin Society, (20 years), and many other groups.

He gave his worldwide collection of 18,000 mounted and 5,000 unmounted specimens of lepidoptera to Citrus College, Azusa, California in January, 1963.

He was first married May 20, 1913 to Lela Bertha Kumm, who died in 1944. Two children were raised, Virginia L. Harmon and Lowell H. Hulbirt.

His second marriage, February 10, 1946, was to Sarah N. Galt, widow of Peter Galt, who resides at 950 Garden Way, Ashland, Oregon.

JOHN A. COMSTOCK, *1373 Crest, Del Mar, California*

RECENT LITERATURE ON LEPIDOPTERA

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here. Papers of only local interest and papers from this *Journal* are listed without abstract. Readers, not in North America, interested in assisting with the abstracting, are invited to write Dr. P. F. Bellinger (Department of Biological Sciences, San Fernando Valley State College, Northridge, California, U.S.A.). Abstractor's initials are as follows:

[P.B.] — P. F. Bellinger
[I.C.] — I. F. B. Common
[W.C.] — W. C. Cook
[A.D.] — A. Diakonoff
[J.D.] — Julian Donahue
[W.H.] — W. Hackman
[T.I.] — Taro Iwase
[T.L.] — T. W. Langer
[J.M.] — J. Moucha
[E.M.] — E. G. Munroe
[N.O.] — N. S. Obraztsov
[C.R.] — C. L. Remington
[J.T.] — J. W. Tilden
[P.V.] — P. E. L. Viette

B. SYSTEMATICS AND NOMENCLATURE

Niculescu, Eugen, "Papilionidae" [in Rumanian]. *Fauna Republicii Populare Romine*, vol. XI, fasc. 5, 103 pp., 8 pls., 32 figs. Academy of Sciences, Bucuresti. 1961. [price 6,40 Lei]. In the introductory part the author describes the taxonomy of all genera of Roumanian Papilionidae with remarks on the exotic species also. In the taxonomic part (pp.41–103) all spp. which occur in Roumania are described. In this country occur: *Papilio machaon, Iphiclides podalirius, Zerynthia polyxena, Z. cerisyi, Parnassius mnemosyne*, & *P. apollo*. [J. M.]

Niculescu, E. V., "Quelques remarques sur *Pieris napi bryoniae* Hbn. (Lep. Pieridae)" [in French]. *Bull. mens. Soc. linn. Lyon*, 30: 232–234. 1961. For the author, *bryoniae* is not a *bona species*, only a subspecies of *P. napi* of the high altitudes. [P. V.]

Nieuwenhuis, E. J., "On the female of *Charaxes mars* Stgr. 1886 (Lepidoptera, Nymphalidae)." *Ent. Berichten*, 19: 37–40, 2 figs. 1959. Describes & figures ♀♀ of *C. m. mars* (previously unknown) & *C. m. dohertyi* (unique) from Celebes. [P. B.]

Nieuwenhuis, E. J., "A new subspecies of *Danaus albatus* Zinken (Lepidoptera, Danaidae)." *Ent. Berichten*, 20: 67–68, 1 fig. 1960. Describes as new *D. a. wegneri* (Rana Mese, Flores). [P. B.]

Nieuwenhuis, E. J., "*Euploea algea melanopa* Röber 1887 (Lepidoptera, Danaidae)" [in Dutch; English summary]. *Ent. Berichten*, 20: 217–218. 1960. On identity of species. [P. B.]

Nieuwenhuis, E. J., "Over de *Vindula*-species in het oostelijk deel van de Indonesische archipel en op Nieuw-Guinea" [in Dutch; English summary]. *Ent. Berichten*, 22: 69–76, 4 figs. 1962. Describes as new *V. dejone ambonensis* (Ambon), *V. arsinoe moluccana* (Telewang, Halmaheira). Distinguishes the spp. & their races in New Guinea & Indonesia. [P. B.]

Obraztsov, Nikolaus S., "*OSTHELDERIELLA amardiana*, neue Gettung und Art der Tribus Laspeyresiini (Lepidoptera, Tortricidae)" [in German]. *Mitt. münchner ent. Ges.*, 51: 150–153, 1 pl., 2 figs. 1961. Type locality Sardab Valley, Elburs Mts., 1,000–1,400 m, N. Iran. [P. B.]

Obraztsov, Nikolaus, "Zwei neue und zwei wenig bekannte palaearktische *Argyroploce*-Arten (Lepidoptera, Tortricidae)" [in German]. *Mitt. münchner ent. Ges.*, 51: 154–158, 4 pls. 1961. Describes as new *A. ernestiana* (Akshehir, 1,000 m, Anatolia), *A. pfeifferiana* (Achyr Dagh, Bertiz Jaila, 1,800 m, S. Syria). Notes on *A. predotai* & *A. hyperboreana*, with descriptions of ♂ genitalia. [P. B.]

Obraztsov, Nicholas S., "North American species of the genus *Eana*, with a general review of the genus, and descriptions of two new species (Tortricidae)." *Jour. Lepid. Soc.*, 16: 175–192, 7 figs. 1963. Describes as new *E.* (*SUBEANA*) (type *canescana*); *E.* (*Ablabia*) *subargentana* (17 mi E. of Mayfield, Utah), *E.* (*A.*) *idahoensis* (Alturas L., Idaho).

Okada, Muneo, "The genera *Evippe* and *Stenolechia*, of Japan, with the descriptions of two species of the latter (Lepidoptera: Gelechiidae)." *Trans. Shikoku ent. Soc.*, 7: 41–53, 5 pls. 1961. Describes as new *S. issikiella* (Sakai, Osaka Pref.). Transfers *Recurvaria dorsalis* & *R. syrichtis* to *Evippe*; redescribes these spp. & *S. notomochla*, & describes larvae of the *Evippe* spp. (food plants *Lespedeza* & *Pinus*, respectively). [P. B.]

Okada, Muneo, "The family Xylorictidae of Japan (Lepidoptera)." *Trans. Shikoku ent. Soc.*, 7: 81–96, 5 pls. 1962. Gives characters of family & of the 4 Japanese genera, keys to genera, & descriptions of 5 of the 8 Japanese spp.; 4 are new to Japan. [P. B.]

Okano, Masao, "Descriptions of a new species and a new genus of Plusiinae from Japan (Lepidoptera: Noctuidae)." *Insecta matsumurana*, 25: 91–92, 1 fig. 1963. Describes as new *NEOPLUSIA* (monobasic), *N. furihatai* (Fujisaki, Homori Pref., Honshu). [P. B.]

Oku, Toshio, "A new mint borer of Tortricidae from Japan, with description of a new genus (Lepidoptera: Tortricidae)." *Insecta matsumurana*, 26: 104–107, 2 figs. 1963. Describes as new *ALLOENDOTHENIA* (monobasic), *A. menthivora* (Nokkeushi, Hokkaido); detailed description of larva. [P. B.]

Oku, Toshio, "Descriptions of two new alpine moths of Archipsini from Japan (Lepidoptera: Tortricidae)." *Insecta matsumurana*, 25: 93–95, 1 fig. 1963. Describes as new *Lozotaenia kumatai* (Nagayamadake, Mt. Daisetsu, Hokkaido); *Clepsis insignata* (Mt. Daisetsu). [P. B.]

Opler, Paul, & Jerry A. Powell, "Taxonomic and distributional studies on the western components of the *Apodemia mormo* complex (Riodinidae)." *Jour. Lepid. Soc.*, 15: 145–171, 1 pl., 1 fig. "1961" [1962]. Describes as new *A. m. tuolumnensis* (Grand Canyon of the Tuolumne, Calif.), *A. m. dialeuca* (5 mi NE of La Encantada, Sierra San Pedro Martir, Baja Calif.).

Orfila, Ricardo N., "Las Dalceridae (Lep. Zygaenoidea) argentinas" [in Spanish]. *Rev. invest. agric.*, 15: 249–264, 1 pl., 12 figs. 1961. Proposes n. subfam. ACRAGINAE. Describes as new *DALARGENTINA* (Acraginae) & type *D. sexquicentenaria* (Parque Nacional Iguazú, Misiones, Argentina); *Dalcera haywardi* (Salta, dep. Orán, Vespucio, Río Aguai, Argentina). Redefines family & Argentine genera (including *Acraga* & *Zaldacra*); redescribes the 3 known Argentine spp. [P. B.]

Orfila, Ricardo N., "*Morpho breyeri* sp. n. (Lep. Morphidae)" [in Spanish; English summary]. *Rev. Soc. ent. Argentina*, 26: 145–147, 1 pl., 4 figs. 1963. Type locality Caranda, 600 m, prov. Ichilo, dep. Santa Cruz, Bolivia. [P. B.]

Orfila, Ricardo N., & Sergio Schajovskoy, "Geometridae (Lep.) del Parque Nacional Lanin (Argentina). III. Géneros y especies nuevos de Ennominae" [in Spanish; English summary]. *Physis*, 24: 1–10, 3 pls. 1963. Describes as new *MARTINDOELLOIA*, & type *M. juradoi* (Pucará); *FRANCISCOIA*, & type *F. morenoi* (Pucará); *DAGOSTINIA*, & type *D. fasciata* (Pucará); all from Lanin National Park, Neuquen Prov., Argentina. [P. B.]

Ōta, Kyôzô, & Hiroyuki Kusunoki, "*Strymonidia*-butterflies of Shikoku, with the description of a new species." *Trans. Shikoku ent. Soc.*, 5: 101–103, 1 pl. 1957. Describes as new *S. iyonis* (Mt. Saragamine, Ehime-ken, Shikoku). Records & figures of *S. w-album fentoni* & *S. mera*. [P. B.]

Paclt, Jiri, "Genera of the Hepialidae (Insecta, Lepidoptera)." *Jour. Asiatic Soc.*, 19: 141–148. 1953. Agrees (with Eltringham and Ford) that importance of genital armature is overrated as a taxonomic criterion. Attempt to revise generic classification with a key that omits 3 little-known genera. Designates *Hepialus ammon* Wallg. as type of new genus *EUDALACINA*. List of new generic syn-

onymy of Hepialidae. Includes a brief correction to his diagnosis of *Lossbergiana pseudodimiata* that appeared in *Tijdschr. Ent.*, 91: 149–152. [J. D.]

dos Passos, Cyril F., "Taxonomic notes on some Nearctic Rhopalocera. 2. Papilionoidea." *Jour. Lepid. Soc.*, 15: 209–225. "1961" [1962].

dos Passos, Cyril F., "The authorship of three scientific names of Nearctic Rhopalocera variously credited to Boisduval or Lucas." *Jour. Lepid. Soc.*, 16: 45–46. 1962.

dos Passos, Cyril F., "The dates of publication of the *Histoire Générale et Iconographie des Lépidoptères et des Chenilles de l'Amérique Septentrionale*, by Boisduval and Le Conte, 1829–1833[–1834]. *Jour. Soc. Bibliogr. nat. Hist.*, 4: 48–56. 1962. Gives probable dates of publication of 26 parts & of 5 generic & 29 specific names proposed in the work. [P. B.]

dos Passos, Cyril F., "*Calephelis* Grote and Robinson, 1869 (Insecta, Lepidoptera): proposed use of the Plenary Powers to designate a type-species in conformity with current usage." *Bull. zool. Nomencl.*, 20: 313–320. 1963. Proposes naming *virginiensis* as type, and suppressing *Nymphidia* & *Lephelisca*. [P. B.]

dos Passos, Cyril F., "Supplemental notes to previous taxonomic notes on some Nearctic Rhopalocera." *Jour. Lepid. Soc.*, 17: 103–104. 1963.

dos Passos, Cyril F., "A synonymic list of the Nearctic Rhopalocera." *Mem. Lepid. Soc.*, no.1, 145 pp. 1964. See Review by F. M. Brown, *Ent. News*, 75(5): 138-140.

Pastrana, José A., "Una especie nueva de Lyonetiidae de la Argentina (Lepidoptera)" [in Spanish; English summary]. *Acta zool. lilloana*, 17: 217–219, 2 figs. "1959" [1960]. Describes as new *Phyllocnistis bourquini* (Tigre, Prov. Buenos Aires; reared from *Tessaria integrifolia*). [P. B.]

Petersen, Björn, "The male genitalia of some *Colias* species." *Jour. Res. Lepid.*, 1: 135–156, 4 pls., 6 figs. 1963. Gives a general description of ♂ genitalia in *Colias* & *Protocolias* & discusses variation in some quantitative characters. Gives a key to these genera, the subgenera *Colias* & *Mesocolias*, & some 35 spp. (not all completely separable). Discusses phylogeny of genus. Figures genitalia of 34 spp. of *Colias* & related genera. It is not clear whether *Protocolias* (type *imperialis*) and *C.* (*Mesocolias*) (type *vautieri*) are new in this paper. [P. B.]

Petersen, Günther, "Identity, synonymy and generic position of *Tinea confusella* H.–S. (Lep., Tineidae)." *Ent. Gazette*, 12: 117–120, 5 figs. 1961. *Obesoceras confusellum* (= *O. danubiellum, O. nigrescens*). *T. "confusella"* of Pierce & Metcalfe is *Infurcitinea captans; T. "confusella"* of Petersen, 1957 is renamed *Infurcitinea banatica.* [P. B.]

Petersen, Günther, "Zur Taxonomie und Verbreitung der paläarktischen *Nemapogon*-Arten (Tineidae)" [in German]. *Acta Soc. ent. Čechosloveniae*, 58: 272–283, 13 figs. 1961. As new are described *N. orientalis* (Beyrouth and Shar Devesy) and *N. levantinus* (Shar Devesy, Haleb); new synonyms: *N. granellus* (= *T. fuscicomella* Steudel in Wörz), *N. flavifrons* Pet. (= *N. kabulianus* Gozm.), *N. agenjoi* Pet. (= *hispanellus* Gozm.). [J. M.]

Petersen, Günther, "Ergebnisse der Albanien-Expedition 1961 des Deutschen Entomologischen Institutes. 3. Beitrag. Lepidoptera: Tineidae" [in German; English & Russian summaries]. *Beitr. Ent.*, 13: 1–20, 4 figs., 1 map. 1963. Describes as new *Infurcitinea albanica* (Kula e Lumës, Albania). Describes ♀ of *Novotinea carbonifera*; figures genitalia of *Monopis monimella.* List of 44 spp. known from Albania, with records, known distribution, & notes on biology. [P. B.]

Petersen, Günther, "Revision der paläarktischen Arten der Gattung *Catabola* Durr. (Lepidoptera: Tineidae)" [in German; English & Russian summaries]. *Beitr. Ent.*, 13: 168–175, 2 pls. 1963. Sinks *Aphrodoxa* to *Catabola*; *Petersenia* to *Catabola* (*Tineomorpha*); *C. perplexa* to *C.* (*Crassicornella*) *zernyi.* Key to subgenera (including *Lazocatena* & *Praelongicera*) and 16 spp. [P. B.]

Petersen, Günther, "2. Beitrag zur Kenntnis der Tineiden von Afghanistan (Lepidoptera:

Tineidae)" [in German; English & Russian summaries]. *Beitr. Ent.*, 13: 176–188, 1 pl., 7 figs., 3 maps. 1963. Describes as new *Infurcitinea nuristanica* (Nuristan: Bashgul Valley, 1,150 m.). Records of 16 spp., with some descriptive notes and new synonymy. List of the 25 spp. known from Afghanistan. [P. B.]

Petersen, Günther, "Zur systematische Stellung von '*Tinea moeniella* Rössler, 1877' (Lepidoptera: Tineidae)" [in German; English & Russian summaries]. *Beitr. Ent.*, 14: 391–393. 1964. Type series includes *Lichenivora nigripunctella* & *Eumasia parietariella.* Sinks *moeniella* to former name; notes on these spp. & on *L. rhenania* (= *nigripunctella* auctt.). [P. B.]

Petersen, Günther, "Zweiter Beitrag zur Kenntnis der geographischen Verbreitung der Tineiden auf der Iberischen Halbinsel (Lepidoptera: Tineidae)" [in German; English & Russian summaries]. *Beitr. Ent.*, 14: 395–420, 10 figs. 1964. Describes as new *Novotinea anadalusiella* (Lanjaron, Prov. Granada, Spain). Annotated list of the 60 spp. known from Spain & Portugal, with some systematic notes & figures of genitalia, and survey of parts of Peninsula where collections have been made. [P. B.]

Pierce, F. N., & J. W. Metcalfe, *The genitalia of the group Tortricidae of the Lepidoptera of the British Isles.* xxii + 101 pp., 34 pls. Reprint, 1960: E. W. Classey. See review in this *Journal*, 15: 127–128.

Pinker, Rudolf, "Biologische Notizen über mazedonische Noctuiden (Lepidoptera, Noctuidae)" [in German]. *Nachrichtenbl. bayer. Ent.*, 12: 97–100, 106–111, 125–127; 23 figs. 1963. Notes on early stages of *Polyphaenis subsericata, Cosmia rhodopsis, Plusia chlorocharis, Blepharita leuconota, Episema lederi, E. trimacula, E. korsakovi,* & *Eugnorisma pontica.* Gives first description of ♀ of *P. chlorocharis.* [P. B.]

Pinker, Rudolf, "Interessante und neue Funde und Erkenntnisse für die Lepidopterenfauna der Kanaren II" [in German]. *Zeitschr. weiner ent. Ges.*, 48: 183–190, 4 pls., 8 figs. 1963. Describes as new *Mythimna saucesa* (Barranco de Agua, La Palma); *Cataclysme grandis lapalmae* (Barranco de Agua, La Palma), *C. g. grancanariae* (Telde, Gran Canaria). Describes early stages of *C. grandis, Episauris kiliani,* & *Sterrha charitata,* & larva of *S. vilaflorensis.* Names "forms" of *C. grandis* & *E. kiliani.* [P. B.]

Povolný, Dalibor, "GNORIMOSCHEMINI trib. nov.—eine neue Tribus der Familie Gelechiidae nebst Bemerkungen zu ihrer Taxonomie" [in German; Czech summary]. *Acta Soc. ent. Čechosloveniae*, 61: 330–359, 14 pls. (3 in color). 1964. New taxa: SCROBIPALPULA (type *S. psilella* H.-S.); *OPACOSIS* subgen. nov. (type *O. inustella*); *Ephysteris treskensis* (Treska Valley, S. Yugoslavia); *Scrobipalpa obsoletella hospes* (Vredendal, S. Africa), *S. erichi* (Tighina, USSR; paratypes from Jericho, Israel & Budapest, Hungary), *S. soffneri* (Nessebar, Bulgaria). New synonyms: *Gnorimoschema pazsizkyi* Rebel (= *Phthorimaea tengstroemi* Hackman); *Scrobipalpa suadella* Richardson (= *P. flavidorsella* Amsel), *S. gallincolella* (Mann) (= *G. philolycii* Hering = *G. reisseri* Gregor & Povolný), *S. intestina* (Meyrick) (= *G. mirabile* Gregor & Povolný). [J. M.]

Povolný, Dalibor, "Resultate einiger Typenuntersuchungen aus der Familie Gelechiidae" [in German; Czech summary]. *Acta Soc. ent. Čechosloveniae,* 61: 53–57, 8 figs. 1964. The types of following spp. are revised: *Neofriseria singula* (Staudinger), *Gelechia scotinella* H.-S., *G. senticetella* (Staudinger), *Aproaerema anthylidella* (Hb.). Genitalia are figured. Discusses synonymy. [J. M.]

Povolný, Dalibor, & Josef Moucha, "Zur taxonomischen Klärung von *Narraga tessularia ilia* Whli. nebst einigen Bemerkungen zu dieser Gattung" [in German; Czech summary]. *Acta Soc. ent. Čechosloveniae*, 59: 152–155, 2 pls. 1962. New taxonomic research on *N. t. ilia* & *N. cappadocica* Herbulot. Genitalia & imagines are figured. [J. M.]

Powell, Jerry A., "Notes on the California species of the genus *Pyla* Grote (Lepidoptera: Pyralidoidea)." *Pan-Pacific Ent.*, 35: 109–114, 4 figs., 1 map. 1959.

Describes previously unknown ♀ of *P. nigricula.* Sinks *P. sylphiella* to *P. scintillans.* Notes on characters & distribution of these spp. & *P. viridisuffusella.* [P. B.]

Powell, Jerry A., "Descriptions of new species of *Argyrotaenia* in the southwestern United States (Lepidoptera: Tortricidae)." *Pan-Pacific Ent.*, 36: 83–97, 12 figs. 1960. Describes as new *A. cupressae* (Los Angeles, Calif.; reared from *Cupressus sempervirens*), *A. beyeria* (Berkeley, Alameda Co., Calif.) *A. paiuteana* (Rock Creek, 1 mi. W. of Tom's Place, Mono Co., Calif.), *A. lautana* (Camp Baldy, San Bernardino Mts., Calif.), *A. burnsorum* (Madera Canyon, 5,800 ft., Davis Mts., Texas), *A. graceana* (Hathaway Creek, San Bernardino Mts., Calif.), *A. martini* (Pine Crest, Mt. Graham, Pinaleno Mts., Graham Co., Ariz., 7,300 ft.). [P. B.]

Powell, Jerry A., "Taxonomic and biological observations on *Pseudexentera habrosana* (Heinrich) (Lepidoptera: Tortricidae)." *Pan-Pacific Ent.*, 37: 203–209, figs. 1961. This species has been confused with *P. oregonana* in collections; the previously unknown female and larva are described.

Powell, Jerry A., "Taxonomic studies on the *Acleris gloverana-variana* complex, the black-headed budworms (Lepidoptera: Tortricidae)." *Canad. Ent.*, 94: 833–840, figs. 1962. *A. variana* is limited to the eastern portion of North America; western populations are assigned to *A. gloverana*, originally described from northern California. Differences include genitalic structure and genital scaling associated with oviposition.

Powell, Jerry A., "Two previously undescribed species of Canadian Archipsini, with a report of the genus *Lozotaenia* Stephens in North America (Lepidoptera: Tortricidae)." *Canad. Ent.*, 94: 841–845. 1962. Describes as new *Archippus tsuganus* (Knight Inlet, B.C., Canada; reared from *Tsuga*), *Lozotaenia hesperia* (Dawson, Yukon, Canada, 1,100 ft.).

Powell, Jerry A., "Biological and taxonomic notes on two California species of *Proteoteras* (Lepidoptera: Tortricidae)." *Pan-Pacific Ent.*, 38: 191–195. 1962. Male genitalia of *P. arizonae* (previously unrecorded from California) are similar to *P. obnigrana Heinrich* rather than that figured by Heinrich from New Mexico. Revised key to larvae is given.

Powell, Jerry A., "Records and description of some interesting species of *Eucosma* in California (Lepidoptera: Tortricidae)." *Proc. Biol. Soc. Wash.*, 76: 235–246. 1963. Describes as new, *E. langstoni* (Pozo, San Luis Obispo Co., Calif.), *E. williamsi* (Oakland Hills, Alameda Co., Calif.; reared from *Baccharis pilularis*); distributional notes on other spp.

Powell, Jerry A., "Biological and taxonomic studies on tortricine moths, with reference to the species in California (Lepidoptera: Tortricidae)." *Univ. of Calif. Publ. Ent.*, vol. 32, 318 pp., 108 figs., 8 plates, 14 maps. 1964. A summary of biologies, geographical distribution, and phylogenetic relationships of and within the Tortricinae, based on observations on the Calif. spp. and on literature for the Nearctic fauna. Comparative biology reveals criteria available for comparison of the three North American tribes of the subfamily. The Archipini is considered to be the most divergent of the three from a presumed ancestral type. Behavioral characteristics of this tribe and the so-called Sparganothinae strongly suggest that the latter group is more closely related to the Archipini than are the Cnephasiini and Tortricini. This confirms the proposal of tribal status for the sparganothines, based on larval characters, by MacKay (1962, Canad. Ent. Suppl. 28). About 35% of the Nearctic fauna, some 57 species, are treated from California, including four spp., and two subspp. described as new: *Acleris keiferi* (San Francisco; reared from *Rubus vitifolia*), *A. paracinderella* (Nevada Co.; reared from *Prunus*), *A. aenigmana* (Truckee, Nevada Co.), *Choristoneura lambertiana californica* (Anderson Springs, Lake Co.), *Argyrotaenia franciscana insulana* (Anacapa Island, Ventura Co.), *A. isolatissima* (Santa Barbara Island, Los Angeles Co.).

Powell, Jerry A., "A review of *Griselda* Heinrich, with descriptions of a related new genus and two species (Lepidoptera: Tortricidae)." *Pan-Pacific Ent.*, 40: 85–97, figs. 1964. Describes as new CHIMOPTESIS (type *C. chrysopyla*, n. sp., San

Francisco, Calif.), *C. matheri* (Clinton, Hinds Co., Miss.); transfers *Griselda gerulae* Heinrich, 1923, and *G. pennsylvaniana* (Kearfott), 1907, to *Chimoptesis,* and *Eucosma hypsidryas* Meyrick, 1925, to *Griselda.*

Powell, Jerry A., "Supplementary notes on North American and Mexican species of *Decodes* and *Argyrotaenia,* with descriptions of new species (Lepidoptera: Tortricidae)." *Proc. Biol. Soc. Wash.,* 78: 65–80, figs. 1965. Describes as new *Decodes lundgreni* (Twain Harte, Tuolumne Co., Calif.), *D. australis* (Jocoque Dam, Aguascalientes, Mexico), *Argyrotaenia lignitaenia* (Pinyon Flat, Riverside Co., Calif.); treats *A. beyeria* Powell, 1960, as subspecies of *A. cupressae* Powell, and *A. lautana* Powell, 1960, as a subspecies of *A. dorsalana* (Dyar); notes on distribution and variation in other spp.

Razowski, Józef, "European species of Cnephasiini (Tortricidae)" [in English; Russian & Polish summaries]. *Acta zool. cracov.,* 4: 179–321, pls. xvii–lxvii. 1959. New spp. & forms are described: *Cnephasia (Cnephasia) sareptana* (Sarepta, USSR); *C. (Anoplocnephasia) minima* (Mostar, Yugoslavia); *Eana incognitana* (Engadin, Switzerland), *E. jaeckhi* (Ecully), *E. rundiapicana* (Bomich), *E. herzegovinae* (Bisina, Hercegovina, Yugoslavia), *E. penziana fiorana* (Mte. Porttella, Abruzzo, Italy); and a new "form." Very important revision of Cnephasiini of Europe. Imagos and genitalia are figured. [J. M.]

Razowski, Józef, "Studies on the Cochylidae. Part II. The genera of the Palearctic Cochylidae" [in English; Polish summary]. *Bull. ent. Pologne,* 30: 281–356, 146 figs. 1960. A number of new genera and subgenera are described (types in parentheses): *OBRAZTSOVIANA* nom. nov. (*Tortrix maculosana*); *PARAHYSTEROSIA* subgen. nov. (*Cochylis simoniana*); (*SUBSTENODES* subgen. nov. (*Cochylis pontana*); *PARASTENODES* subgen. nov. (*Cochylis meridiana*): *EUSTENODES* subgen. nov. (*Euxanthis dorsimaculana*); *BIPENISIA* subgen. nov. (*Cochylis jucundana*); *CERATOXANTHIS* gen. nov. (*Cochylis argentomixtana*); *EUXANTHOIDES* gen. nov. (*Tortrix straminea*); *BLESZYNSKIELLA* subgen. nov. (*Tortrix alternana*); *PARAXANTHOIDES* subgen. nov. (*Cochylis chamomillana*); *PROCHLIDONIA* gen. nov. (*Tortrix amiantana*); *CRYPTOCOCHYLIS* gen. nov. (*Cochylis conjunctana*); *LONGICORNUTA* gen. nov. (*Cochylis phaleratana*); *NEOCOCHYLIS* subgen. nov. (*Cochylis calavrytana*); *PARACOCHYLIS* subgen. nov. (*Cochylis amoenana*); *BREVICORNUTIA* subgen. nov. (*Cochylis pallidana*). The family Cochylidae (= Phaloniidae) contains in the Palearctic region 24 genera of which 5 are described as new. From the taxonomic point of view an important study of this family. Heads, venation, and genitalia are figured. [J. M.]

Razowski, Józef, "Studies on the Cochylidae. Part III. On some studies from the collection of Dr. S. Toll" [in English; Polish summary]. *Bull. ent. Pologne,* 30: 397–402, 10 figs. 1960. Describes as new *Phalonidia tolli* (Manchuria, Djalantun, Prov. Kirin) and *Eupoecilia citrinana* (Manchuria, Hsiaoling, Prov. Kirin); many new combinations. *Phalonidia chlorolitha* (= *Phalonia azyga,* n. syn.). Describes also two "forms" of *Cochylidia subroseana.* Types & their genitalia are figured. [J. M.]

Razowski, Józef, "The genitalia of some Asiatic Tortricidae described by E. Meyrick" [in English; Polish summary]. *Bull. ent. Pologne,* 30: 381–396, 22 figs. 1960. The genitalia are described & figured. All 19 types examined belong to the Paris Museum. Describes as new *LASPEYRESINIA* (type *Eucosma metacritica*) and *CHOGANHIA* (type *Argyroploce sphaerocopa*). A number of new combinations. [J. M.]

Razowski, Józef, "Etude des types de tordeuses de M. D. Lucas et P. Réal" [in French]. *Bull. Mus. nat. Hist. nat.,* Paris, ser. 2, 32: 528–535. "1960" [1961]. Study of the types of spp. of leafrollers described by these authors; many taxa are synonyms. [P. V.]

Razowski, Józef, "Studien über die Cochylidae (Lepidoptera). Teil V. Cochylidae-Typen in Naturhistorischen Museum in Wien" [in German]. *Zeitschr. wiener ent.*

Ges., 46: 23–28, 14 figs. 1961. Notes on 28 types, giving label data, generic assignment, & brief descriptions or figures of genitalia. [P. B.]

Razowski, Józef, "Studies on Cochylidae. Part VI. Remarks on the types of some Cochylidae" [in English; Polish summary]. *Bull. ent. Pologne*, 31: 301–319, 36 figs. 1961. Describes as new *PROHYSTEROPHORA* (type *Cochylis chionopa*) and *Euxanthoides hannemanni* (Israel: Jordan Valley and Jerusalem). Many new combinations & new synonyms. [J. M.]

Razowski, Józef, "Two new species and one new subspecies of the genus *Cnephasia* Curt. (Tortricidae)" [in English; Polish summary]. *Bull. ent. Pologne*, 31: 105–107, 4 figs. 1961. Describes as new *C. jozefi* (Aflou, Prov. Oran), *C. tremewani* (Sidi-bel-Abbès, Prov. Oran), and *C. sareptana alatauana* (Ala Tau Mts. and Aremnia, Eriwan). The genitalia of all new forms are described and figured. [J. M.]

Razowski, Józef, & Tosiro Yasuda, "Description of new Japanese *Acleris*-species (Lepidoptera, Tortricidae)" [in English; Japanese summary]. *Trans. Lepid. Soc. Japan*, 14: 80–89, 36 figs. 1963. Describes as new *A. simplex* (Tokusawa, Nagano Pref.), *A. hokkaidana* (Hokkaido), *A. electrina* (Kasugayama, Nara Pref.), *A. crassa* (Hosono, Nagano Pref.), *A. phantastica* (Sigakoogen, Nagano Pref.), *A. ophthalmica* (Sigakoogen), *A. takeuchii* (Ikeno, Gifu Pref.), *A. roxana* (Takayama, Gifu Pref.); *A. ulmicola* is a good species. [P. B.]

Rebillard, P., "Révision systématique des lépidoptères nymphalides du genre *Agrias*" [in French]. *Mém. Mus. nat. Hist. nat.*, n.s., *A, Zool.*, 22: 157–254, 1 col. pl., 2 pls. 1961. Study of the morphology and the geographical distribution of the genus *Agrias*. Bibliography of the 300 and more names included in this genus. [P. V.]

Reisser, Hans, "*Hyphantria cunea* Drury in Europa (Lepid., Arctiidae) (Der 'amerikanische Webebär')" [in German]. *Zeitschr. wiener ent. Ges.*, 45: 51–61. 1960. Discusses problem of correct name for form found in Europe, concluding that *textor* is merely an extreme pale variant. Translates Drury's and Harris's descriptions. Surveys literature on occurrcence and biology in Europe, with comments. [P. B.]

Reisser, Hans, "Beiträge zur Kenntnis der Sterrhinae (Lep., Geom.) V. Was ist *Sterrha dilutaria praeustaria* Lah. (Mann i.l.)?" [in German]. *Zeitschr. wiener ent. Ges.*, 47: 21–24. 1962. Describes as new *S. d. illyrica* (Illyria, Tergeste, Cerovlje); "praeustaria" is a "form." [P. B.]

Reisser, Hans, "*Ocneria eos* sp. nov., eine neue Lymantriide aut Kreta (vorläufige Beschreibung)" [in German]. *Nachrichtenbl. bayer. Ent.*, 11: 9–10, 3 figs. 1962. Type locality Genni Gavé, N. Crete. [P. B.]

Reisser, Hans, "Weitere neue Heteroceren aus Kreta" [in German]. *Zeitschr. wiener ent. Ges.*, 47: 193–216, 4 pls., 9 figs. 1962. Describes as new *Axia vaulogeri nesiota* (Assites, 800 m.); *DANIELOSTYGIA* (monobasic), *D. persephone* (Wurwulitis); *Phragmacossia albida minos* (Knossos); *Cryphia rectilinea insulicola* (Assites, 500 m.), *C. raptricola cretica* (Ida, Silva Rouva, 1,300 m.); *Phragmatoecia erschoffi* ("Buchara Haus —"). Redescribes *Ocneria eos*. Comparative notes on *Phragmacossia* spp. & *Phragmatoecia*. Notes on *Cosymbia ariadne* & *Dyscia crassipunctaria* (names a fall generation). List of recent additions to the fauna of Crete. [P. B.]

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(New names in **boldface**; synonyms in *italics*)

NOTICE TO CONTRIBUTORS TO THE *JOURNAL*

Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11″ paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal*. Legends of figures and tables should be submitted on separate sheets.

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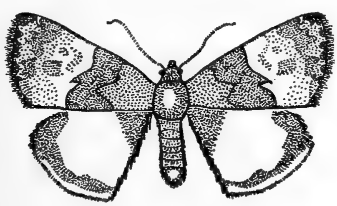

In This Issue

(Complete contents on back cover)

15 March 1966

The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

Active Members—annnal dues $6.00 (U. S. A.)
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Dues may be paid in Europe to our official agent: E. W. Classey, 353 Hanworth Road, Hampton, Middx., England.

In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is Yale University, Peabody Museum, New Haven, Connecticut. Second class postage paid at Lawrence, Kansas, U.S.A.

Journal of
The Lepidopterists' Society

Volume 20 1966 Number 1

APPLICATION OF AUTOMATION IN RHOPALOCERA RESEARCH

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5027 N.E. 23rd Ave., Portland, Oregon

In the 1890 census of Baltimore, Maryland, Dr. Herman Hollerith introduced the first punched card method of tabulating data (Copeland, 1949). Since that time, punched card procedures have mushroomed to the point where automated tabulating processes are being utilized in almost all phases of science and industry.

To date, automated procedures in the Rhopalocera field are few. It is true that some experimental, and highly controversial, work has been carried on in the taxonomic area—witness the recent papers of Ehrlich, Rohlf, Sokal, Michener, and Sneath, among others. The scope of this pilot work is quite limited as of yet, though implications indicate a much broader investigation of this lucrative field by butterfly taxonomists.

From compilation of punchcard data, the volumes of *Forest Lepidoptera of Canada* (McGugan, 1958; Prentice, 1962, 1963) have been realized, and forest entomologists in the United States are also accumulating data on punchcard file systems (Powell, 1965).

My desire, stemming from a speculative note by J. W. Tilden in the March, 1962, issue of the *Lepidopterists' News*, is to acquaint the average collector with automated tabulating machines, with the primary emphasis on recording field records and observations of collectors, and standardization of collecting procedures.

The equipment mentioned is commonly in use today in banks, offices, and department stores and is mentioned here due to its relatively low cost. Many more elaborate computing or tabulating systems, such as International Business Machines (hereafter abbreviated to IBM) highly versatile 1401 series (Anonymous, 1961), are on the market today.

As we frequently see in the news media, the Federal Government is underwriting huge sums annually to other deserving aspects of natural science. Perhaps a grant from the National Science Foundation or a similar organization would be sufficient to start the project. Already Cornell

University has produced a *Pilot Register of Zoology* (W. L. Brown, 1964) for card listing of all living and fossil organisms. Perhaps soon a project of that type may be developed on a continuing basis.

The U. S. Department of Agriculture presently has in operation a system adapted to the study, by automatic data processing, of range plants (Garrison & Skovlin, 1960). The plants each have a number, in a general catalog, and when noted in the field, a coded report is sent to the central office where it is punched in a card and processed on tabulating machines.

Since 1950 the Canadian Forest Insect and Disease Survey has utilized standardized procedures of recording field data on punch cards. At present, close to a million records have accumulated, with an annual inflow of new records close to 50,000 (C. E. Brown, 1964). In 1962, programming a Univac Solid State Computer, maps of Lepidoptera distribution were produced for Canada, utilizing methods described by C. E. Brown (1964).

The Punch Card

The punch card, when properly prepared, can produce automatically, and at high speed, an almost unlimited number of statistical comparisons (Arkin & Colton, 1964). The card is the actual controlling agent of all the machines through which it passes, causing itself to be counted, printed, classified, sorted in a sequence, collated in sequence, compared, selected, reproduced, edited, coded, and decoded, plus doing all the normal arithmetical operations.

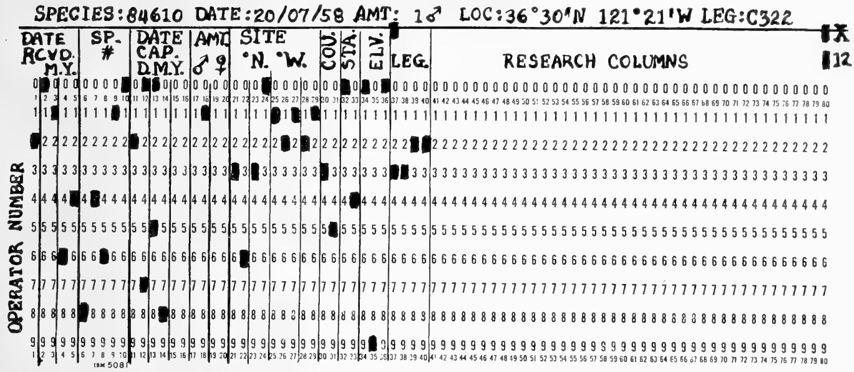
The card is divided into 12 horizontal columns and 80 vertical columns. The horizontal values indicate a general topic, as date or species, while the vertical values give a specific value to each subject. In Fig. 1 is reproduced a standard IBM punch card. The specific fields (areas to be punched, like date and species) may be marked off in any desired arrangement.

The vertical columns have 12 general positions for punching, the two at the top being known as 12 or X punch areas, which are used as controls, or to identify a specific card. Thus an X punch in column 47 might indicate that the card carries special data on *Euphydryas*.

Some possible card field descriptions, with regard to butterfly data, are as follows:

Date card punched. The first card field, or first five columns of the IBM card, would be reserved for the date the card was actually punched and a code number for the keypuncher.

Species number. Card columns six to 10 could be reserved for a number



EXPLANATION OF FIGURE

Fig. 1. The IBM punch card, as would conceivably be used in an entomological IBM installation.

to be ascribed to each "species." This number does not, of course, have to be five spaces long, but that gives sufficient room for general locality records of some 99,999 different varieties to be numbered.

Locality. Present methods of citing localities will not suffice for use on IBM cards. The only logical approach for a punch card is with latitude and longitude. This would necessitate collectors keeping track of this new information for each collecting site.

County and state. Vast numbers of cards would be sorted by species and geographically, to facilitate manual handling. This would be accomplished by coding the county and state of the locality from any standard atlas. The numbering would not need to be limited to North America, but could cover the world.

Elevation. The altitude of capture would best be stated in hundreds of feet or meters above sea level.

Collector. Each collector would have an assigned number, determined automatically as data is received from that collector.

Since the machines print alphabetical figures, the first figure of an individual's number would consist of the first letter of his last name, i.e., John Doe, being D422.

Remaining columns. Those columns remaining could be utilized in any means desired. Any type of information could be coded by number, the data being dependent on standardization—the key word in automation. The areas could be used in any field of research, with entries of taxonomic, climatic, genetic, or other interests. These columns may be X or 12 punched in any specific column to indicate any one of several hun-

dred different areas of research. The specialist, then, need only develop a code for his area of study, and publish it in a suitable medium.

I emphasize the policy of nonspecialists doing the basic fieldwork specifically for the purpose, that it is intolerable that the specialist should have to do all his own sampling (Ehrlich, 1961b), often covering years of research, when abundant punch card data could be within easy reach.

Determinations. It is rare, even with experts, when 100% accuracy in determinations is realized. The use of numerical taxonomy should quantify this greatly, by giving numerical limits to degrees of variation. This data, if to be properly utilized, must then be presented in a usable form to novice collectors, so that accurate carded data may be forthcoming.

Perhaps then, general instructions could be presented to collectors, developing a special taxon, procedure, or covering a related area such as ecology, genetics, or taxonomy. After completion of these instructions, specialists may reasonably expect a high degree of accuracy in the information submitted concerning those specialized areas studied by the amateur. In turn, one can also expect the novice to become proficient, and eventually a specialist in his own area of interest. If a pilot project of this sort could be sponsored by the Society, it might be well to investigate it further.

The Data Processing Machines

The actual data processing system consists of numerous machines, each designed for a specific purpose, and all with an extreme range of function.

The keypunch. Data received from collectors must be punched in code numbers onto cards. This is done on a keypunch, a typewriter-like machine that punches holes rather than printing. The holes are then read by various machines, through which the card passes, by means of metal brushes completing a circuit through the cards, the body of the card acting as an insulator.

The reproducer (*IBM 514*). Where large amounts of similar information are to be punched, a reproducer is utilized, which copies, or "gang punches," the data from the preceding card.

When connected to the IBM 407 tabulator, the 514 acts as a "summary punch," punching totals accumulated on the tabulator into new cards to reduce handling of large volumes of similar cards.

The interpreter (*IBM 552*). When data is to be manually handled a great deal, as will large volumes of butterfly record cards, the punched holes may be printed on the top of the card, so as to be read visually.

The sorter (*Several makes*). The sorter is used to put the cards into

any type of sequence or order. This machine can select, group, or reject the numbers on any single column. Quite probably, new incoming cards will be sorted by collector, county, state, and species (sorting the most minor area first), and collated with the main file.

The collator (IBM 085). To facilitate filing of the cards, a collator is used to merge groups in a common sequence. New cards will then be easily merged with the main file, rather than a time-consuming sorting process, due to the 085's ability to read 80 columns simultaneously. This machine may also be used to select groups of common card fields or control punches.

The tabulator (IBM 407). The tabulator is used to list all the coded data. It is another machine with many uses, and can add and subtract the card data while printing, besides cut a summary card on the IBM 514.

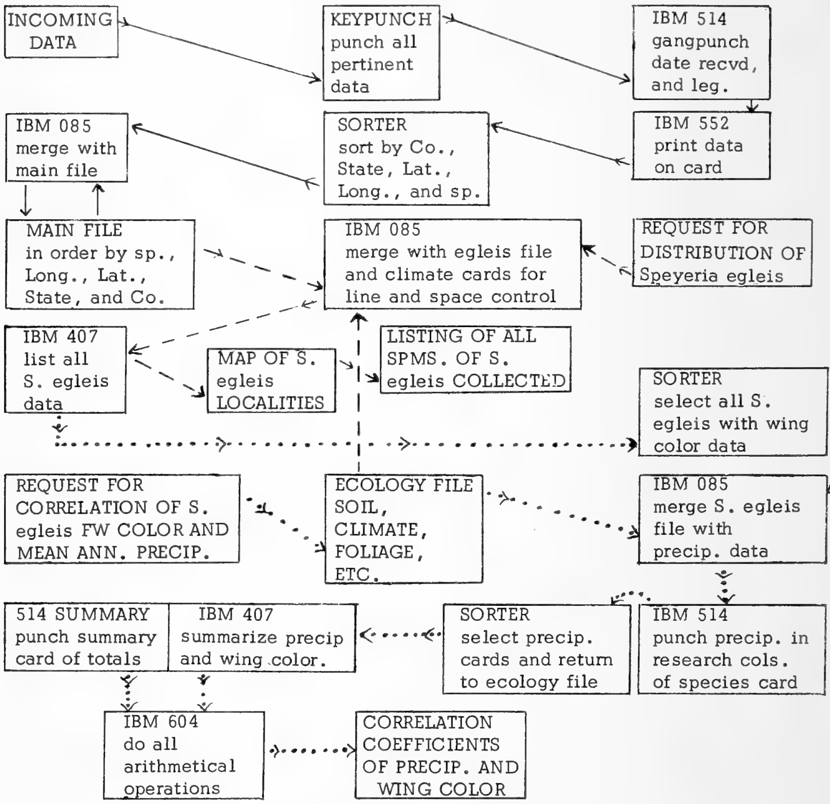
A wiring panel on this machine gives an almost unlimited field of alternate working functions, each function being controlled by individual control wires on the panel. The IBM 514, 552, 085, and 602–604 systems also have this control panel.

The computer (IBM 602–604). Oftentimes there is a need for mathematical formulas to be solved in large numbers. This is done by a computer, and can handle most problems encountered in statistical comparisons, correlations, or ratios. A disadvantage of this specific machine is its relatively slow speed.

Operation of the Machines

Figure 2 shows the flow of information from collection of data to its dispersal in a typical operation. A quick sort yields all the cards of a species in a given region for those who desire listings of all available information on distribution in an area. By sorting on latitude and longitude, the IBM 407 can put a series of dots in sequence on a sheet of paper, the student needing only to add a map outline which has been printed to scale, in order to receive the known distribution of that species in the area of interest (see C. E. Brown, 1964). Another request on correlation of wing length and precipitation would be summary punched to find totals, the cards having sums figured on the computer. Thus, any type information desired, if punched on the cards, may be arranged in any manner and printed, whether a simple sort is required for a distributional study or a complex selection process comparing several factors against each other is desired.

In practice, quite probably collectors would be asked to supply the raw field data to be punched in the cards described. Figure 3 is a suggested format for consolidating field data. The area to the left would



EXPLANATION OF FIGURE

Fig. 2. The flow of data cards through an IBM installation. Solid line indicates path of new data to main file. Short dashes indicate path of data in request for distribution. Dotted line indicates path of data in request for correlation of data.

serve for the IBM card, the balance of written material being for the collectors' convenience. The format is not copyrighted, and may be copied.

In the checkered area at the bottom of the card, coded data of research interest would be written. The control figures on the left indicate what the following information might consist of, and how to control it. On the card, "Taxo. X-45" indicates taxonomic data, the control punch an X in column 45. The circled column indicates the first punch and last punch of a field, the number being the number of the column. The coded number itself will represent a value for a standard taxonomic feature, as genitalic measurement ratios or wing pattern elements.

CODED DATA	
05360:SPECIES	SPECIES: Lycaena cupreus Date:12 Jul 64
120764:DATE	Co: Harney State: Oreg. SPM # 1256
1 male:AMOUNT	LOCALITY DETAIL: 12 Miles NNW of Burns, Hy. 395. In small ravine in Pine forest, along Theimer Creek.
$43^{\circ}35'$:LAT.	TWP: 21S RAN: 31E SEC: center of 15
$119^{\circ}56'$:LONG.	WEATHER: abt. 85°, few cumulus, wind light
13 :COUNTY	PLANTS NOTED: Willow and Aspen underbrush, Lodgepole Pine dominant, Lupines abundant.
37 :STATE	Leg:C.R. Crowe Det by:C.R.C.-July 1964
50 :ELV.	
C211 :LEG.	

OTHER SPECIES PRESENT: helloides, editha, and rubidus.
MISC. DATA: Benchmark at base of ravine is BM4950'. Dock was common in marshy spots along the creek and along the road. specimens were visiting goldenrod.
CODED RESEARCH DATA REQUESTED BY SPECIALISTS.

TAXO. X in col. 45	29 2 3 5 6 8 4 4 5 2 1 6 4 2 3 1 1 0 5	46
ECOL. 12 in col. 72	72 2 1 4 4 5	80
CLIM. X in col. 47	47 2 3 1 1 0 3 2 6 5 1 1 3 7 2 5 0	63

Explanation of Figure

Fig. 3. The suggested field data card format (not copyrighted). With this type of card, all raw data concerning butterflies will be collected and punched on a standard punch card format.

On some of the more controversial genera, as in *Speyeria*, *Euphydryas*, and *Colias*, areas of common ground will have to be agreed on, so that a number may be applied to any given specimen. There, of course, will be some specimens that resist numbering, but probably can be broken down statistically and defined by numerical taxonomic methods and procedures.

Species

Some systematists would attempt to consolidate various species and form names (Hovanitz, 1943), ignoring variants from the original description or types. Others, more versatile, even attack basic species concepts (Ehrlich, 1961a). Realizing that probably both have some useful application, it is necessary for automation to approach the recording area with a general compromise.

As the primary usefulness of data processing lies in standardization of all values to be coded, it is noticed that members of many genera are quite resistant to any form of pigeonholing. It would appear from some recent literature (Ehrlich, 1961a, b; Ehrlich & Holm, 1962) that a species or subspecies is only a signpost along a long trail, and the post is

planted only at the convenience of the original describer of the first specimen. Ehrlich and Holm believe this type of thinking is now slowly on the decline as it becomes more obvious that the clear-cut "biological species" concept is nonexistent in many cases, with the distinctness of many of our own butterfly species probably being vastly overrated.

Recently Ehrlich demonstrated a method of discriminating specimens by comparing their taxonomic features. That is, *Euphydryas editha colonia* would no longer be a name, but a concept expressed with a specific number representing coded values of certain taxonomic characters. These numbers, in thèmselves, would replace conventional methods of naming of various supposedly "distinct" entities found in the field. Names, then, will be retained only as a convenience in speaking or writing of a very wide group.

Ehrlich (1961a) after a careful analysis of 74 different characters on 13 specimens of *Euphydryas*, was able to construct with automated equipment (Burroughs 220, checked on IBM 650 series) a statistical diagram that revealed significant discriminatory information of the specimens, and established a base for speculaton on origins. It is probable that in most cases, after a preliminary investigation of great numbers of characters with each taxon, the total number might be simplified and standardized to those characters that are most significant. Stroud pioneered in this statistical area using only 14 characters in a study of termites (Sokal & Michener, 1958). More, perhaps, would be necessary to accumulate significant data with most of our genera, but the possibilities that novice collectors, with simplified procedures and equipment, might be of value in this field are great.

The present literature offers many examples of standardization suitable for widespread usage with automated equipment. Hovanitz (1943) has formulated a table for California *Speyeria callippe*, which need only be extended to other *callippe* forms, and addition of other characteristics than wing color patterns. In conjunction with Jude Le Gare (1951), he diagrammed and coded the pattern elements of *Melitaea chalcedona*, which may be applied to any form of *Euphydryas*, again adding other characteristics to better represent the known variation. These are only two of the many noted examples. By compiling, editing, and coding variable features of a species, then, eventually standardized procedures may be developed with which one may adequately deal with any butterfly variation found in the field or produced in the laboratory.

A notable quote from Ehrlich (1961a): "The continued presence of authors' names following the names of species of North American butterflies is, in most cases, a waste of type." "Citation of authors' names as a

matter of course should cease." To my way of thinking, the present dos Passos checklist (1964) should be used as a standard directory, ignoring authors, until such time as a truly knowledgable and meaningful change in the status of the names may be made. With governing by the International Commission on Zoological Nomenclature, the rules and names comprise a usable system, but perhaps another, more usable system, should replace it.

Some Advantages of Automation

A great number of existing possibilities for every collector and interest is apparent, besides having all records available even though files or collections may be lost through accident or demise.

New specialists would be attracted to the field, making contributions from their own knowledge and specializations. Mathematicians and statisticians will be involved directly in the project, adding their training and experience to that of the taxonomist.

Of necessity, the record-keeping practices of participating collectors will improve. Vast amounts of information normally ignored, or lost in field notebooks, will come to light.

With a listing of all localities that have been collected, "blank" areas of previously uncollected areas will be noted, and perhaps collected, adding new distributional data to the files.

The only requirement of card punching, as mentioned earlier, is standardization of data, so that any conceivable type of data may be preserved on the punched card and compared in a statistical analysis with any other type of data.

With latitude and longitude accurately determined, it is possible to punch other sets of cards with extensive ecological data: climatological means, soil data, solar radiation maps, radioactive background counts, foliage cover and plant or tree distributions, geological maps, and other type of information found in a standardized format that could be carded. This data could be collated with that of the butterfly specimens to yield considerable information on life habits, habitats, and distributions, besides giving a means of comparing taxonomic features with ecological data to find, possibly, a previously unknown or unsuspected correlaton.

The long, tedious, computations necessary in correlating could be carried out rather simply with automated equipment. Large volumes of data could be automatically correlated as a matter of course, resolving obscure questions on pattern and ecology relationships, or other similar problems.

Presently, the U. S. Navy has ventured into electronography (Plain, 1964), with electronic taping of entire pieces of literature. With their present equipment, some 17,400 characters are composed per second, with enlarged microfilm negatives being printed at the rate of 240 an hour. This, in the future, then, would allow a specialist to microfilm every collected specimen and present it to the computer. At the press of a button, every known fact about that species could be at hand, along with photographs of every specimen recorded. Fantastic, I admit, but such a process is well within the realm of possibility.

SOME DISADVANTAGES OF AUTOMATION

Fred Thorne (1964) writes that in the past, development of the Annual Season Summary series has had many difficulties, both in getting members to cooperate and in getting them to use the now standardized format. How, then, would members cooperate in the gigantic task of accumulating the necessary data for automation? A difficult question, which could be answered during the eventual trial of automated data processing.

The IBM equipment cannot perform miracles, and even the simplest operation may consume considerable time. This would necessitate research priorities, and possibly long waiting lists. To circumvent general requests of a distributional nature, the task of preparing the Annual Season Summary could be assumed by the machines, only reporting on a much wider scope, giving species listings, or maps, of every specimen reported during that year. After sufficient data is collected and compared with ecological data, distribution maps of probable range could be easily issued. These maps could then be accumulated by collectors, and used to solve most distributional problems.

Needless to say, many "specimen hunters" or commercial collectors will take neither the time nor effort to support a project of automated nature.

SUMMARY

It is inevitable that one day a system similar to that described shall have to be initiated in this field. Presently, collections are becoming so vast, and scattered among so many institutions and individuals, that any major study is becoming quite difficult, through the sheer volume of data to be accumulated and processed.

If a forecast were required, I should call for a vast system of interlocked computers, handling the new information as it is collected and correlating the mass with giant stores of previous entries. We can probably look forward to an institution that determines individual collectors'

annual catch, for the privilege of microfilming the specimens and submitting the data to the computer. The vast amount of literature concerning butterflies will be scanned and all relevant information and facts taped or stored in the computers—the factual data being emitted in a single lump at the push of a button. The system will spread to encompass not only butterflies, but all insects, plants, and animals, present and extinct.

Quite probably, before the end of the next few years stimulating entomological papers of significance will be forthcoming from those not directly interested in entomology, but in statistics, mathematics, and automated equipment. While emphasis on nomenclature sinks to obscurity, data emitted from the bowels of an electronic maze of transistors, wires, and memory cells will formulate new concepts concerning behavior, comparative anatomy, genetics, geographical and ecological distribution, and evolutionary trends.

The author was graduated from the Western Automation Institute in Portland, Oregon, and for a year and a half before entering the meteorology field, operated the equipment mentioned in this report.

I wish to offer my thanks to L. P. Grey, Dr. J. A. Powell, and F. T. Thorne for their invaluable aid with criticisms and suggestions on this paper.

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CERCYONIS PEGALA NEPHELE (SATYRIDAE) AT FLUORESCENT LIGHT

Having read the recent notices of Rhopalocera taken at light, both in the *Journal of the Lepidopterists' Society* and the *Entomologist's Record and Journal of Variation*, I was most interested to find another species attracted to fluorescent light. While collecting Noctuidae in the company of John Newman at Morenci, Michigan, on the evening of July 31, 1965, using a 15-watt "BL" fluorescent black light suspended before a white sheet on a frame, a male *Cercyonis pegala nephele* (Kirby) was seen to fly at the lighted sheet and react in the same manner as a nocturnal insect. It was obviously attracted by the light, and soon settled upon the ground flap.

Due to the location of the apparatus and other circumstances, it is safe to say that the butterfly was not mechanically disturbed from its resting place, but was actually drawn by the lamp. We had seen the species occasionally while collecting in the afternoon. The specimen was taken at approximately 10:30 P.M., and a light rain of over two hours' duration had just ceased, reinforcing the certainty of attraction.

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THE EFFECT OF CERTAIN ENVIRONMENTAL FACTORS AND CHEMICALS ON THE MARKINGS OF *PIERIS RAPAE* (PIERIDAE)

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Introduction

It is well known (Klots, 1951; Comstock and Comstock, 1943) that the dark markings of *Pieris rapae* (Linnaeus) are somewhat reduced, or even entirely absent (form *immaculata*), in the spring brood, which emerges from overwintering pupae. Therefore, the markings are capable of being diminished by particular factors that are involved in the spring brood, and the present work is essentially an attempt to reduce the markings by means of light and temperature variations and, especially, incorporation of certain chemicals in the larval diet.

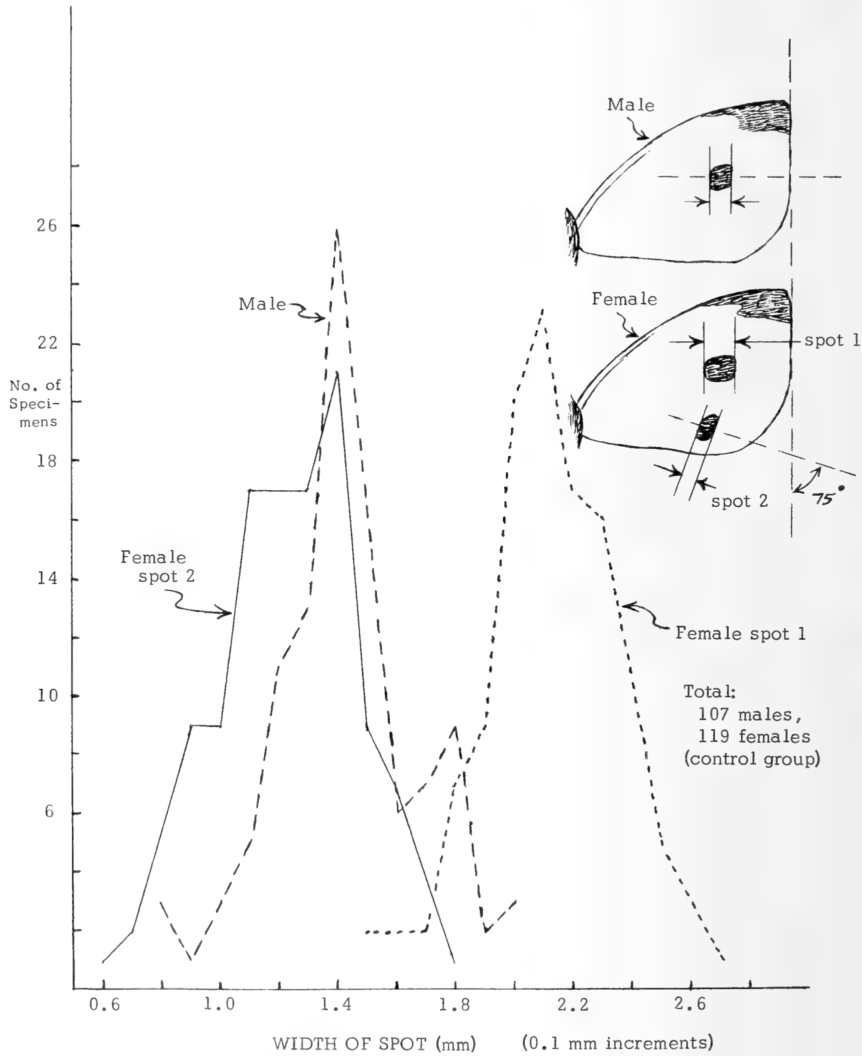
Rearing Procedure

In the course of the experiments, five consecutive broods were reared indoors beginning with eggs laid by females captured at Morristown, New Jersey (July 2, 1964) and Doylestown, Pennsylvania (July 4, 1964). Inbreeding was not very close, because a number of pairs from each brood were mated and the eggs of mixed parentage reared together to give the next brood. There was no evidence of declining vigor in the development rates; the durations of stages for the second and fifth broods (control groups) were not greatly different, as seen below.

Brood	Date Eggs Laid	Relative Humidity (%)	Temp. (°F.)	No. of Days			
				Eggs Laid	Hatched	Pupation	Eclosion
2	July 31, 1964	51–66	68–86	0	3	21–27	29–31
5	Nov. 15, 1964	36–53	67–75	0–2	3–7	21–24	30–34

Incidentally, typical S-shaped curves were obtained by plotting length of the largest larva vs. time; in the case of the first brood, the largest larva increased from one mm (calculated to be about 2×10^{-5} grams) at hatching to a maximum of 25 mm (0.25 grams) in the course of 14 days, and the same increase in length took place in the case of the third brood in 15 days. The length of the smallest larva in the third brood increased from two mm on the seventh day after hatching to only 10 mm on the 19th day, showing the wide range in growth rates among individuals.

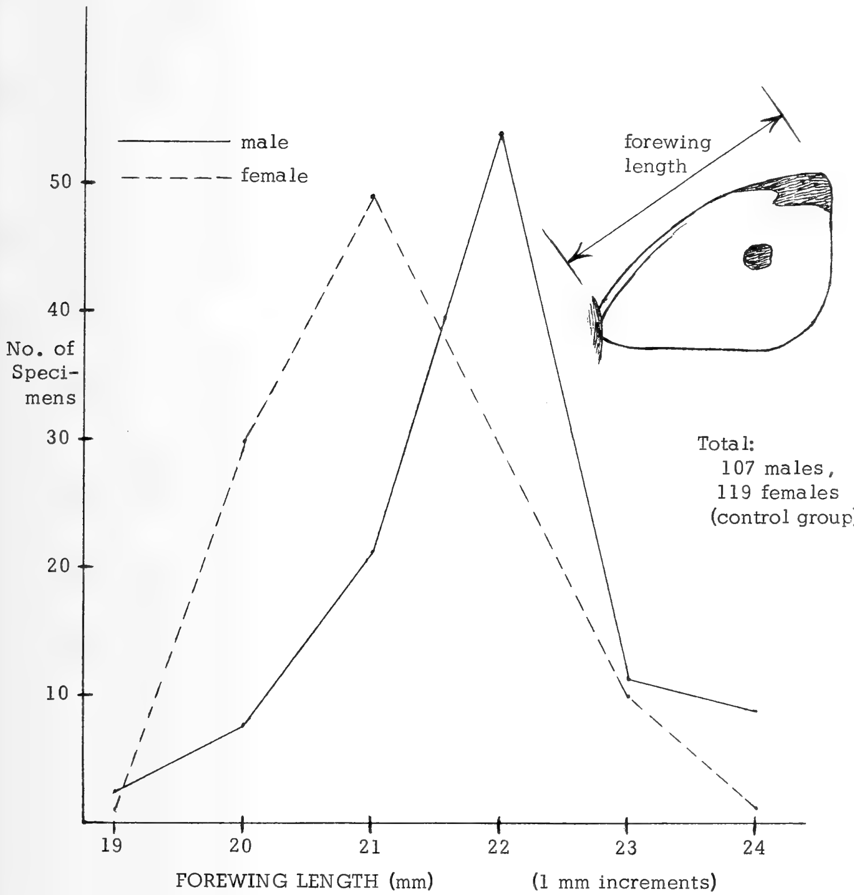
The larvae were fed cabbage leaves from refrigerated heads and were reared in cardboard boxes (4.5 inches high and 9 inches square with a gauze window 5.5 inches square in the lid) in diffuse light.



Explanation of Graph 1

Frequency curves for wing spot widths in *Pieris rapae* (L.).

Mating was accomplished by exposing about 10 to 75 adults (roughly equal numbers of the sexes) in a screen cage (16 inch cube) to direct sunlight for one or two days. Then cabbage leaves were hung up on the sunny side of the cage for two or three successive days to obtain a yield of several hundred fertile eggs. In certain cases, a single pair was mated by exposing to sunlight in a jar, and the offspring were reared separately,



EXPLANATION OF GRAPH 2

Frequency curves for wing length in *Pieris rapae* (L.).

but since variation in the markings for offspring of a single pair was as great as the general variation, groups of mixed parentage were used for most purposes.

Chemicals were fed by sprinkling a fine powder from salt shakers, liberally onto the cabbage leaves. The chemicals were obtained from Matheson, Coleman, and Bell Co., with the exception of hydroquinone (from B. and A. Division, Allied Chem. Corp.) and 4-chlororesorcinol (from Koppers Co.; recrystallized to give a capillary melting point of 108.5–110° C.). Chemical feeding was initiated when the larvae had reached a length of 7–23 mm (3–8 mm in the case of tyrosine and phenylalanine).

TABLE 1
EFFECT OF PUPAL COLOR AND OF REFRIGERATION OF PUPAE ON ADULT WING SPOTS

MALES							
		Wing	No.	Spot (mm)			
Pupal Color	Refrig-erated	Length (mm)	Speci-mens	Range	Average	AD	SD
green	no	23	5	1.0–1.6	1.3	0.14	0.19
brown	no	22	9	0.9–1.9	1.3	0.24	0.29
green	yes	22	8	1.3–1.7	1.5	0.14	0.15
brown	yes	22	6	0.9–1.6	1.4	0.33	0.35
FEMALES							
		Wing	No.	Spot 1 (mm)			
Pupal Color	Refrig-erated	Length (mm)	Speci-mens	Range	Average	AD	SD
green	no	22	7	2.1–2.5	2.3	0.13	0.15
brown	no	22	3	1.8–2.9	2.2	0.43	0.51
green	yes	21	4	1.9–2.5	2.1	0.25	0.26
brown	yes	21	5	1.8–2.5	2.1	0.20	0.24
		Wing	No.	Spot 2 (mm)			
Pupal Color	Refrig-erated	Length (mm)	Speci-mens	Range	Average	AD	SD
green	no	22	7	1.2–1.6	1.3	0.07	0.13
brown	no	22	3	0.9–1.9	1.3	0.40	0.44
green	yes	21	4	0.9–1.6	1.2	0.22	0.26
brown	yes	21	5	0.8–1.4	1.2	0.18	0.22

MEASUREMENT OF MARKINGS

In order to provide a quantitative parameter, the width of the forewing spots (one in the male, two in the female) was measured, and, since the spots are variable even among the offspring of a single pair, it was necessary to express results statistically by means of a range, an average, an average deviation (AD), and a standard deviation (SD). As will be seen (Tables 1–4), no emphatic reduction in the average was encountered for any test group. Intensity of the markings, as opposed to width, was not measured but was found to be diminished markedly, especially for the apical area, in certain cases (Plates 1–3).

The spots were measured as shown in Graph 1 by means of a 6-power comparator with 0.2 mm scale divisions (Edmund Scientific Co., Barrington, N.J., No. 30,169 in Catalog 645). Estimation was necessary because the edges of the spots are not very sharply defined, but good agreement was obtained among controls (Tables 1–3).

TABLE 2
VARIABILITY IN SIZE OF WING SPOTS

MALES						
Group	Wing Length (mm)	No. Speci-mens	Spot (mm)			
			Range	Average	AD	SD
Control	22	107	0.8–2.0	1.4	0.18	0.25
Offspring of single pair	22	6	0.9–1.7	1.4	0.15	0.24
Wild sample[1]	23	25	1.0–1.9	1.5	0.16	0.22
Wild (Spring Brood[2])	22	21	0.6–1.3[3]	1.0[3]	0.16[3]	0.20[3]

FEMALES						
Group	Wing Length (mm)	No. Speci-mens	Spot 1 (mm)			
			Range	Average	AD	SD
Control	21	119	1.5–2.7	2.1	0.18	0.24
Offspring of single pair	21	11	1.5–2.5	2.0	0.24	0.29
Wild sample	22	4	1.5–2.3	2.0	0.25	0.30
Wild (Spring Brood)	22	15	1.4–2.2	1.8	0.17	0.21
Group	Wing Length (mm)	No. Speci-mens	Spot 2 (mm)			
			Range	Average	AD	SD
Control	21	119	0.6–1.8	1.2	0.20	0.24
Offspring of single pair	21	11	0.4–1.5	1.1	0.20	0.27
Wild sample	22	4	1.2–1.8	1.5	0.20	0.22
Wild (Spring Brood[2])	22	15	0.7–1.8	1.2	0.30	0.33

[1] Collected at Doylestown, Pennsylvania, October 4, 1964.
[2] Collected at Flemington, New Jersey on May 1, 1965.
[3] These values are for the 10 specimens with spots; the others (11) had no spots (0–10 black scales in area where spot should be).
NOTE: The spring brood females tended to have dusky basal regions on the forewing and weak or absent apical markings.

Forewing lengths were measured as shown in Fig. 2 and averaged for each set of wings. Then the spot measurement for each wing was normalized to the mean wing length by multiplying by the quotient of the mean length divided by the particular length. Average deviation (AD) and standard deviation (SD) calculations indicated that approximately normal curves were obtained (Graph 1).

PUPAL COLOR

Pupal color was studied to some extent, the main interest being in checking for correlation with adult markings.

In many cases, pupae were definitely either brown or pale green, but

TABLE 3

EFFECT OF LIGHT AND TEMPERATURE ON SIZE OF WING SPOTS

(Wing lengths normalized to 22 mm for males, 21 mm for females)

MALES

Group	No. Specimens	Spot (mm)			
		Range	Average	AD	SD
Control (1); 18 hrs. light/day	107	0.8–2.0	1.4	0.18	0.25
Control (2); as above	16	1.1–2.0	1.5	0.25	0.30
Reared in darkness (1)	11	0.7–2.1	1.2	0.30	0.38
Reared in darkness (2)	18	1.3–2.2	1.6	0.13	0.19
Darkness and cold[1]	7	1.2–1.7	1.4	0.17	0.19

FEMALES

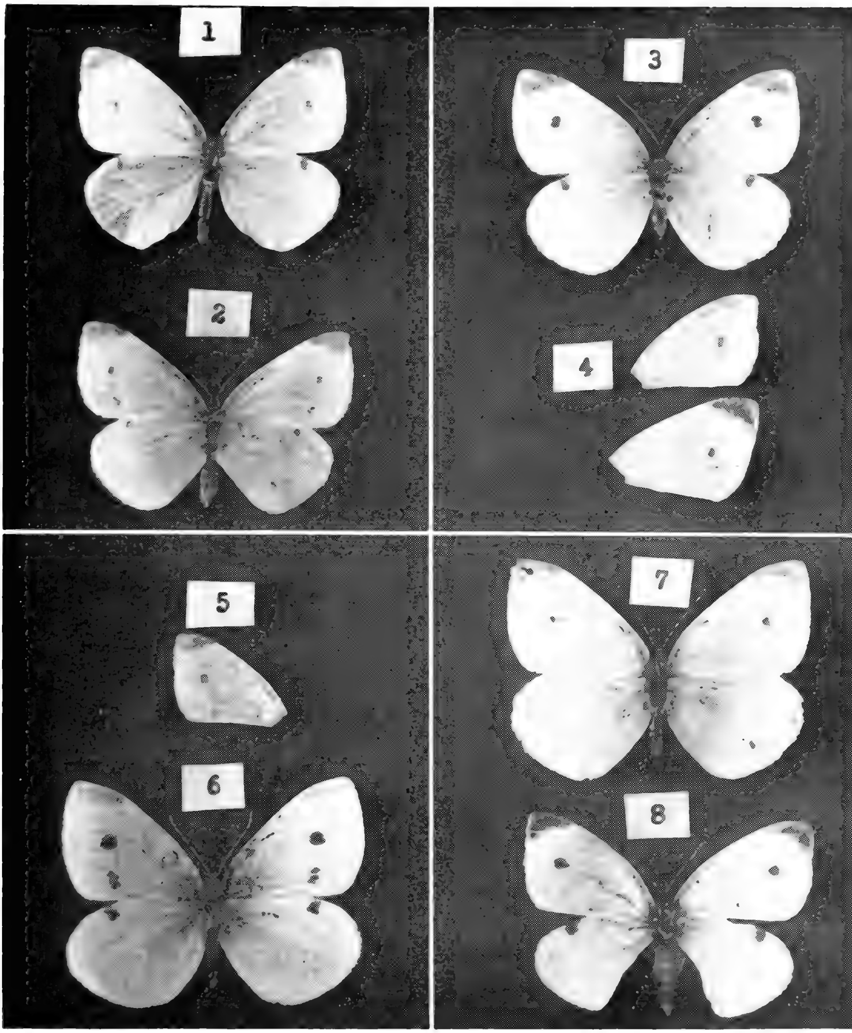
Group	No. Specimens	Spot 1 (mm)			
		Range	Average	AD	SD
Control (1)	119	1.5–2.7	2.1	0.18	0.24
Control (2)	18	1.4–2.6	2.0	0.25	0.33
Reared in darkness (1)	6	1.7–2.1	1.8	0.15	0.21
Reared in darkness (2)	16	2.0–2.9	2.5	0.23	0.26
Darkness and cold[1]	10	1.9–2.7	2.3	0.18	0.22

Group	No. Specimens	Spot 2 (mm)			
		Range	Average	AD	SD
Control (1)	119	0.6–1.8	1.2	0.20	0.24
Control (2)	18	0.6–2.2	1.3	0.32	0.40
Reared in darkness (1)	6	0.7–1.4	1.1	0.20	0.25
Reared in darkness (2)	16	1.0–1.9	1.5	0.19	0.24
Darkness and cold[1]	10	0.9–1.7	1.4	0.19	0.23

[1] The larvae, after reaching 3–8 mm, were reared at 37–68° F. and 38–78% rel. humidity, in darkness. Pupae were kept at 33–68° F. and 44–80% rel. humidity, in darkness, until eclosion.

there were all variations between, so that the colors often had to be judged subjectively, making the following numbers only approximate. Also, there was a shift toward green (see below) as the pupae matured. Ultimately, of course, darkening before eclosion obscured the original colors.

Sex ratio.—A pair that had eclosed from green pupae was mated, and the resulting larvae gave 16% green among the male pupae (total of 25) (36% after 3 days) and 33% green among the female pupae (total of 15) (60% after 3 days). This shows that neither sex necessarily has an essential monopoly on the green color. Incidentally, larvae are easily sorted by sex by means of the subcutaneous dorsal markings (presumably testes)



EXPLANATION OF PLATE I

Pieris rapae (L.) specimens with unusual markings. 1, ♂, larva fed 4-chlororesorcinol, light markings; 2, ♀, larva fed *p*-aminobenzoic acid, unusually light markings; 3, ♀, larva fed *p*-aminobenzoic acid, spot 2 absent; 4, ♂, larva fed cysteine·HCl, no black scales in spot of upperside shown; 5, ♂, larva fed ascorbic acid, no black scales in spot; 6–8, reared at reduced temperatures (see "dark and cold" group, Table 3), 6, ♀, light apical markings, 7, ♂, light markings, 8, ♂, pupal case on abdomen.

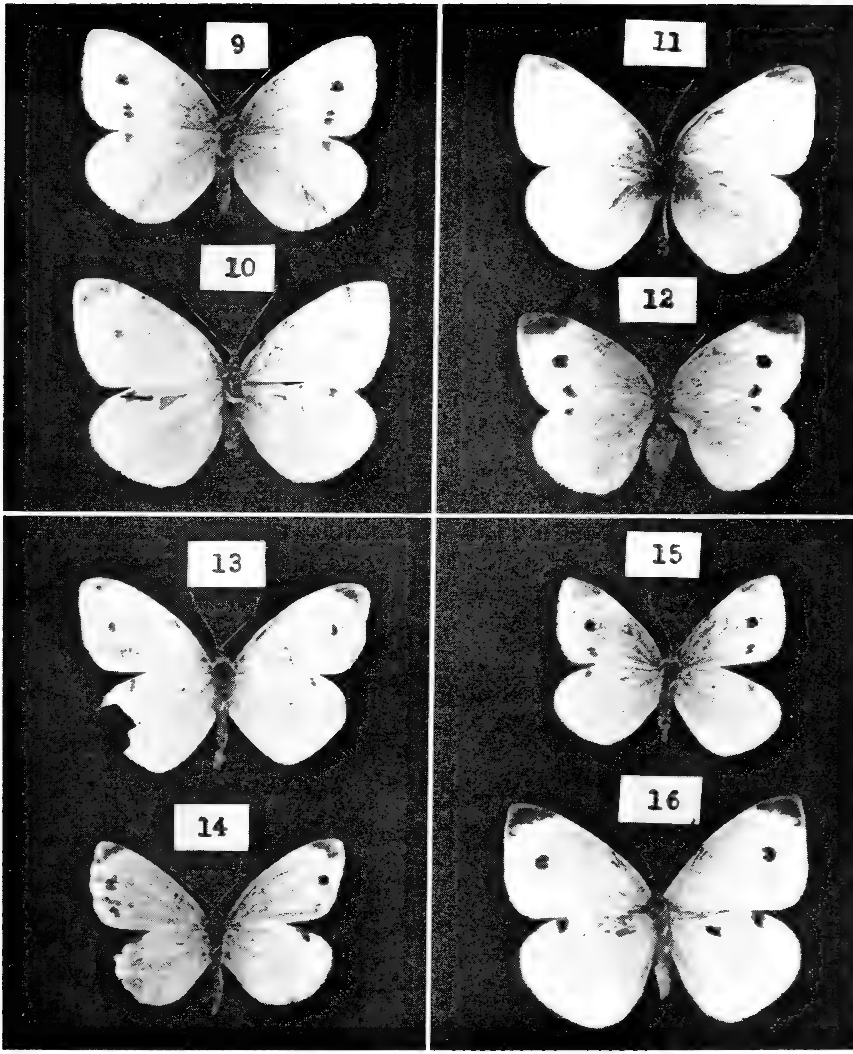
in the male. In one case, 27 male larvae were sorted from 17 females, the sexes being verified when the adults eclosed.

Inheritance.—Larvae obtained from a pair which had eclosed from green pupae produced 21% green pupae (of total of 39), while brown-pupa parents gave larvae which yielded 28% green pupae (of total of 108). A single pair of brown-pupa parents gave larvae which produced 35% green pupae (of total of 31). Therefore, under the conditions of this particular test, pupal color of the parents had no control over pupal color of the offspring. However, it has been reported (Harrison, 1928) that the green pupal color, inhibited by orange light, in *Pieris napi* (L.) and *Pieris brassicae* is inherited.

Photoperiod.—Larvae which were reared and pupated in darkness gave only brown pupae (of total of 93). With 18 hours of light/day, offspring of a single pair (from brown pupae) gave 24% green pupae (of total of 17), while the combined offspring of several brown-pupa pairs produced 30% green (of total of 330). With 10 hours light/day the offspring of a single pair of brown-pupa parents produced 29% green pupae (of total of 17). Thus it seems that reduction of the photophase from 18 to 10 hours had no pronounced effect but that complete absence of light gave only brown pupae. That darkness causes brown pupae in *Pieris rapae* has been reported (Okamoto, 1960). This reference also states that the pupal color is determined by photostimuli in the fifth instar larva and that the wavelength and quantity of light reflected from the pupal site is of great importance. However, in the present work there was no definite trend towards green pupae in those regions (such as the gauze window) of the rearing boxes that received the most light.

Chemical effects.—Larvae fed phenylalanine gave 7% green pupae (of total of 29), and those fed tyrosine gave 24% green (of total of 17), while the control group gave 22% green (of total of 135). Increased melanin formation caused by phenylalanine (see discussion below) would explain the low proportion of green pupae, though this is a doubtful rationalization.

In another series of experiments, the following melanogenesis inhibitors gave the percent green pupae in parentheses: 4-chlororesorcinol (61%, of total of 23), *p*-aminobenzoic acid (26%, of total of 31), cysteine hydrochloride (14%, of total of 8), and ascorbic acid (8%, of total of 24). The control gave 38% (of total of 24). There is no obvious correlation in these data; the very high proportion of green pupae obtained with 4-chlororesorcinol might be rationalized as inhibition of pigmentation, but there would seem to be an opposite effect with the other melanogenesis inhibitors. It is to be understood that the biochemical reaction sequences which may be initiated by these chemicals are unknown.



Explanation of Plate II

Pieris rapae (L.) specimens with unusual markings. 9–10, larvae reared at reduced temperatures (see "dark and cold" group, Table 3), 9, ♀, light apical markings, 10, ♂, light markings; 11–12, larvae exposed to ultraviolet light (mostly 366 millimicrons) for total of 18 hours, 11, ♂, spot very light, almost absent, 12, ♀, pupal case on abdomen; 13–15, larvae fed tyrosine, 13, ♂, apical black scales partly missing, 14, ♀, spot 1 nearer margin, 15, ♀, apical markings very light; 16, ♂, larva fed phenylalanine, markings normal.

Effect on adult markings.—Pupae which were definitely either brown or green were selected and allowed to develop and eclose under ambient conditions (72–81° F., 36–55% relative humidity) or were placed (within three days following pupation) in refrigeration (0–2° C., 100% relative humidity) for one week and then allowed to develop and eclose under ambient conditions (69–81° F., 35–55% relative humidity). The time from pupation of the first to eclosion of the last was 12 days for unrefrigerated pupae and 19 days for refrigerated pupae. The results are given in Graph 1. No significant variation in size of the forewing spots was found with respect to pupal color (or as a result of refrigeration under the specified conditions).

ADULT WING MARKINGS

Variability of spots.—Graph 2 shows the variability in the size of the spots for a large control group of mixed parentage, the offspring of a single pair, and a series of wild specimens collected at Doylestown, Pennsylvania, on October 4, 1964. Frequency curves for the control group of 226 specimens are shown in Graph 1. It is seen that normal frequency curves are approximately defined by plotting the number of specimens having a particular size spot vs. spot size in 0.1 mm increments. For the control group, normal curves also are produced by plotting number of individuals with a particular length vs. wing length in 1 mm increments as shown in Graph 2. For wing length, AD was 0.70 for males or females, and SD was 1.1 for males and 0.96 for females. This means that at least 99% of wing lengths will fall within 15% (for males) or 14% (for females) of the mean, while, for the same control group, the variance is 54% for the male spot, 34% for female spot 1, and 60% for female spot 2. Thus, the spots are much more variable than the wing lengths. It will be noted that the SD in the tables lies between 0.15 and 0.38 for the male spot, 0.13 and 0.51 for female spot 1, and 0.13 and 0.44 for female spot 2.

It may be concluded from examining Table 2 that the spots were as variable within a brood as within the general population.

Effect of light and temperature.—Table 3 shows the results for (1) the large control group, raised with 18 hours light/day, (2) another control group, also raised with 18 hours light/day, (3) groups from different broods reared in darkness from the time the larvae reached 4–10 mm in length to eclosion (two males and one female were refrigerated with no noticeable effect on the spots), and (4) a group reared in darkness at reduced temperatures. Note that the lack of effect of refrigeration when initiated after pupation, was mentioned above.

For one brood (1) reared in darkness, the indication is that the spots may have been diminished slightly in size. However, in the other brood

Table 4

EFFECT OF CHEMICALS (FED TO LARVAE) ON SIZE OF WING SPOTS

MALES

Chemical	Mortality (%)[1]	No. Specimens	Wing Length (mm)	Spot (mm) Range	Average	AD	SD
DL-β-phenylalanine	88	10	21	1.0–2.0	1.5	0.22	0.28
L-tyrosine	84	6	22	0.8–1.9	1.5	0.33	0.38
4-chlororesorcinol	45	12	22	1.1–1.9	1.6	0.15	0.20
p-aminobenzoic acid	41	13	22	0.8–1.7	1.5	0.19	0.25
L(+) cysteine·HCl	85	3[2]	21	1.2–1.7	1.5	0.25	0.26
L(+) ascorbic acid	0	13[2]	22	1.2–2.0	1.6	0.20	0.24

FEMALES

Chemical	No. Specimens	Wing Length (mm)	Spot 1 (mm) Range	Average	AD	SD
DL-β-phenylalanine	9	21	2.0–2.7	2.4	0.18	0.22
L-tyrosine	10	20	1.5–2.7	1.9	0.29	0.36
4-chlororesorcinol	9	21	1.9–2.6	2.3	0.18	0.22
p-aminobenzoic acid	15	21	1.0–2.6	2.1	0.27	0.39
L(+) cysteine·HCl	3	19	1.9–2.2	2.1	0.10	0.13
L(+) ascorbic acid	9	21	2.0–2.6	2.2	0.11	0.17

Chemical	No. Specimens	Wing Length (mm)	Spot 2 (mm) Range	Average	AD	SD
DL-β-phenylalanine	9	21	1.3–1.9	1.5	0.13	0.18
L-tyrosine	10	20	0.7–1.5	1.1	0.20	0.25
4-chlororesorcinol	9	21	1.0–1.7	1.4	0.10	0.17
p-aminobenzoic acid	15	21	0.8–1.8	1.2	0.13	0.23
L(+) cysteine·HCl	3	19	0.8–1.3	1.1	0.20	0.22
L(+) ascorbic acid	9	21	1.1–1.8	1.4	0.24	0.26

[1] (100) (no. original larvae – no. of adults obtained)/no. original larvae. Hydroquinone and thiourea gave 100% mortality.

[2] There were no black scales in the spot in the case of one specimen.

(2) there was no indication of decrease in size of either the male or female spots, and no change in intensity was evident.

When a group of larvae, starting at 3–8 mm, was reared in darkness at reduced temperatures (down to 33° F.) so that pupation occurred at 32–50 days vs. 24–36 days for the control, and eclosion began at 62 days vs. 33 days for the control, the spots of the adults showed no general decrease in size (Table 3) or intensity. However, certain individuals were lightly marked apically (Figs. 6, 9), as were none of the large control group. One specimen (Fig. 8) retained the abdominal part of the pupal case.

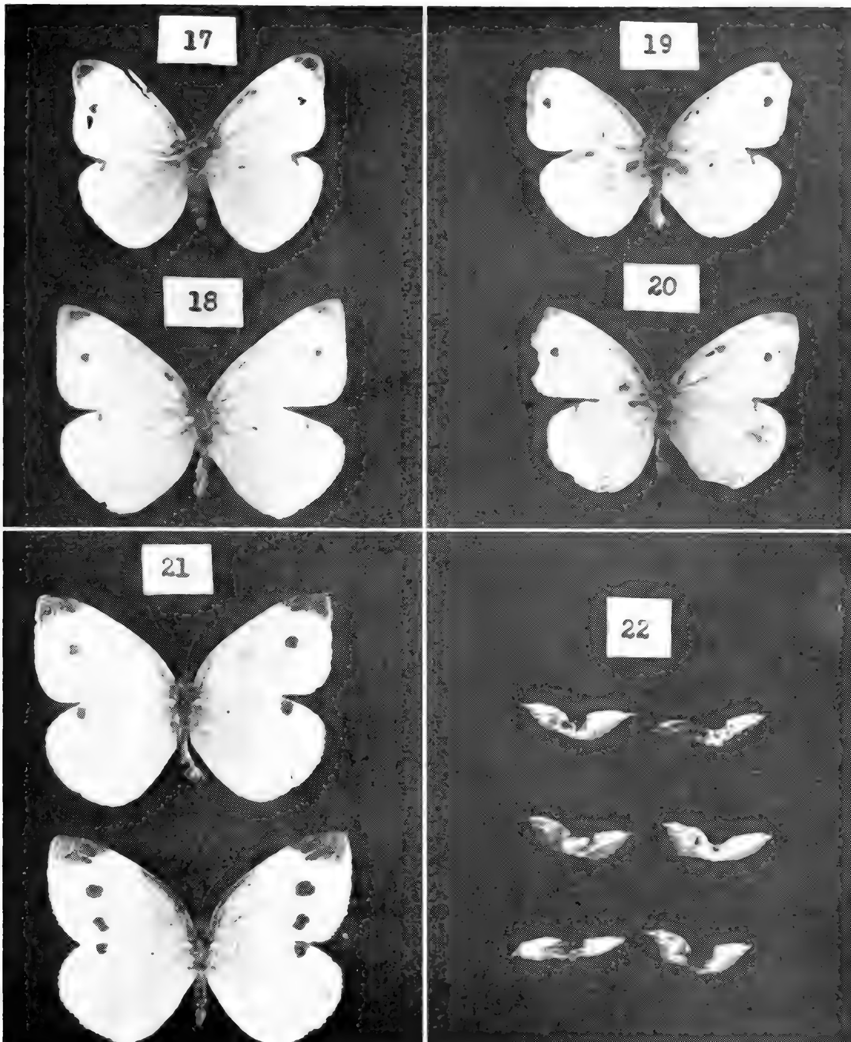
Another group was reared under standard conditions, but the pupae were refrigerated (beginning at 0–4 days after pupation) for 39 days at 32–38° F. (100% relative humidity); the markings were of normal size (averages: male spot 1.4 mm, wing 22 mm; female spot 1, 2.2 mm, spot 2, 1.3 mm, wing 21 mm). Irradiation of larvae with ultraviolet light (mostly 366 millimicrons) for a total of 18 hours, in the case of another group, had no appreciable effect except that one male was lightly marked (Fig. 11) and a female happened to retain the abdominal pupal case (Fig. 12).

It was concluded that those variations of light and temperature which were applied were unsuccessful in consistently reducing the size of the markings from the normal summer-brood range. However, the fact that four of the seventeen specimens reared in darkness at reduced temperature were lightly marked (Figs. 6, 7, 9, 10) suggests that possibly an extension of low-temperature storage (via diapause) following pupation at rather low temperature might produce a consistent effect, as is presumably the natural situation producing the spring brood.

Effect of chemicals.—Curious individual variations were obtained by feeding the larvae certain chemicals active in the process of melanin formation which operates during the pupal stage to produce the dark markings of the adult.

The chemicals were (1) phenylalanine, found in *Pieris brassicae* larvae and food leaves (Stamm and Aguirre, 1955) and starting material for melanogenesis, (2) tyrosine, also a starting material for melanogenesis and found freely in insect blood (Brunet, 1963) and, along with phenylalanine, in silkworm skin (Watanabe, 1956), (3) 4-chlororesorcinol, which causes lack of melanin formation in mosquito larvae (Wallis, 1961) and fish (Kull, Bonorden, and Mayer, 1954), (4) *p*-aminobenzoic acid, an inhibitor of melanogenesis (Lorincz, 1950), (5) cysteine (as the hydrochloride), which is inversely connected with melanin formation in skins of silkworm larvae (Inagami, 1956), (6) ascorbic acid, which inhibits melanogenesis in rabbits (Visetti and Ferrero, 1957) and occurs in cabbage, (7) hydroquinone, an inhibitor of melanogenesis in mice and humans (Denton, Lerner, and Fitzpatrick, 1952), and (8) thiourea, which inhibits melanogenesis in the Planarian eye (Kambara, 1954) and causes abnormal epidermis in the silkworm (Fukuda, 1953). A general discussion of melanogenesis inhibitors and their modes of action is given by Lerner (1953).

In the control group (no chemical fed), the average male spot was 1.5 mm (22 mm wing) and female spots 1 and 2 averaged 2.5 and 1.5 mm (22 mm wing). Therefore, examination of Table 4 shows no general reduction in size of the male spot and little, if any, reduction in size of



Explanation of Plate III

Specimens of *Pieris rapae* (L.). 17–20, larvae fed phenylalanine, 17, ♂, spot nearer margin, 18–20, ♂♂, apical black scales partly missing; 21, ♂ & ♀, control group, markings normal; 22, pupae from larvae fed phenylalanine, deformed, constricted in middle.

the female spots. Also there was no obvious general decrease in intensity of markings. However, several interesting anomalies resulted (Plates 1–3). Light markings were produced by 4-chlororesorcinol (Fig. 1), *p*-aminobenzoic acid (Fig. 2), tyrosine (Fig. 15), and phenylalanine (Figs.

18–20). The latter compound incidentally produced many deformed (constricted) pupae (Fig. 22), which died. Deformed forewings, bearing the spots near the margin, were produced by phenylalanine (Fig. 17) and tyrosine (Fig. 14). Perhaps the most curious peculiarity was the absence of scales (on upper wing surface) in the male spot of one specimen each from the cysteine hydrochloride and ascorbic acid groups (Figs. 4, 5); there were gray scales on the spot on the underside of the wing, and removal of these would give a transparent "window." Hydroquinone and thiourea were larvicidal and produced no pupae.

Thus, the result was a tendency toward depigmentation, perhaps most marked when ingestion was heaviest, with all the chemicals, even though phenylalanine and tyrosine are materials for, rather than inhibitors of, the pigmentation process. This situation is not surprising, however, because strange effects may well result, via obscure biochemistry, from massive overdoses of what normally is ingested in low concentration in the food.

Difference in intensity of markings of the spring and summer broods is said (Pugh, 1934) not to be due to any difference in content of tyrosinase (the enzyme catalyzing melanin formation) in the insect but to some other factor, depending on the temperature at which the pupae are kept. The present work extends this by suggesting that a general change in the markings is not caused by excess phenylalanine or tyrosine (raw materials for melanin) or by inhibitors of tyrosinase.

Therefore, the final conclusion is that the reduced dark pigmentation of the spring brood is not the result of a lowered concentration of phenylalanine or tyrosine in the pupa or in increased concentration of some inhibitor but is due ultimately to the temperature factor, which (with the proper photoperiod) causes the diapause necessary for overwintering.

SUMMARY

1. Pupal color, green or brown, was not correlated with sex nor inherited under the conditions of the test, nor did it affect the markings of the adult. In darkness only brown pupae were produced.

2. Reduced temperature, in conjunction with darkness, caused reduced intensity of markings in about one of every four specimens. Darkness alone (at normal summer temperatures) had no effect on the markings.

3. The feeding of phenylalanine, tryosine, and certain tyrosinase inhibitors to larvae produced sporadic depigmentation effects, including total lack of scales within the male spot, but there was no consistent reduction in intensity of markings.

4. The data suggest that the reduced dark pigmentation of the spring brood of *Pieris rapae* is not the result of lowered concentration of melanin

precursors (since greatly increased concentrations did not increase melanin) or the presence of tyrosinase inhibitors in the pupa but is related to reduced temperature.

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REVIVAL OF *Lepidoptera*

This Danish journal, organ of the Lepidopterologisk Forening in Copenhagen, was published from 1946 to 1951. The first issue of Volume 1 of a new series has now appeared, and includes, among other notes, the first part of a series describing and figuring the Danish *Eupithecia.* One or two issues a year are planned. The editor is T. W. Langer. For subscriptions write the Honorary Secretary, Johs. Storm-Olsen, Rødkildevej 14, Copenhagen F., Denmark.—P. F. Bellinger

A COLONY OF THE EUROPEAN SKIPPER *THYMELICUS LINEOLA* (HESPERIIDAE) AT EDMUNDSTON, NEW BRUNSWICK

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In 1957 I collected for the first time here in Edmundston, N. B. About mid July that year, I noticed some golden brown skippers flying slowly in the grass. Some specimens were collected and checked at home in Klots' Field Guide (1951) as to the species. Much to my surprise, they turned out to be *Thymelicus lineola* (Ochsenheimer).

According to Dr. Klots, the species has been introduced into Ontario, and later reports indicate that the weakly flying skipper has since spread rather widely in northeastern North America (e.g., Thomas, 1952; Muller, 1958).

Here in the city of Edmundston it is extremely abundant, in fact, the most common skipper. In the evenings, when the butterflies become inactive, they roost together by the hundreds in tall vegetations in the "heart" of the colony at the bottom of a hillside, facing the south. We have, however, not noticed it anywhere else in the surrounding area. Adults have a fairly long flight season, being on the wing in early July through August. Judging by the large numbers I have seen year after year, it seems well established here, which to me is something of a surprise, for the winters here in northwestern New Brunswick are extremely cold indeed!

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NEW JOURNAL

The Society Library has received a copy of the first issue of *Entomops*, devoted especially to the insect fauna of southeastern France and Corsica. Quarterly publication is planned; subscriptions are 15 francs in France, 20 francs elsewhere. For subscriptions write *Entomops*, 3, Rue Bergondi, Nice (A.-M.), France.

The first issue includes descriptions of new beetles and Lepidoptera and an article on moths trapped on late winter snow in the Alps. Both contents and layout are of high quality; few entomological journals are as attractive in appearance. The editor is Monsieur F. Dujardin, of Nice, a member of the Lepidopterists' Society.—P. F. BELLINGER

THE LIFE HISTORY OF *SCHINIA NIVEICOSTA* (NOCTUIDAE)

D. F. Hardwick
Entomology Res. Inst., Canada Dept. Agric., Ottawa, Ontario

Schinia niveicosta (Smith)[1] feeds in the larval stage on the blossoms of Spanish needle, *Palafoxia linearis* (Cav.) Lag., an herbaceous perennial composite common in washes and dunes in the Mojave and Colorado deserts of southern California. Although *niveicosta* is not generally well represented in collections, it may become locally very abundant in areas in which its food plant is common. Several hundred specimens of the species were collected between the latter half of February and the first week of April, 1955, in the Indio area of southern California. Although presumably primarily a spring-flier, *niveicosta* may be partially double-brooded, a few moths examined having been collected in October.

I have not seen specimens collected in areas other than southern California and western Arizona, but the range of the species may be coincident with that of its food plant, which is distributed from southern Utah to northwestern Mexico.

Behavior

The adults have a very characteristic manner of resting, head downward, on the pinkish purple flowering heads of the food plant, with which the maculation and coloring of the forewings blend almost indistinguishably (Fig. 1). This position is maintained even during copulation; a few mating pairs were found in the early morning with their heads downward and their abdomens joined over the top or around the side of the flowering head.

The full, globular eyes of *niveicosta*, and the frequency with which it is taken in light traps, suggest that the species is primarily nocturnal. In common with many of its heliothidine relatives, however, it is not exclusively so. The moths are usually quiescent on the blossoms during the morning hours but towards midday they become restive, and during the afternoon they fly at the least disturbance and may often be seen actively feeding on nectar of the food plant.

Among species of *Schinia*, *niveicosta* is relatively fecund; five wild-caught females deposited a mean of 157 eggs, and the maximum deposited by a single female was 183. Eggs are usually inserted into the bud or newly opened flower head from the side, less commonly from the top. The eggs are lodged beneath the sepals or between the inner florets. Occasionally, eggs are deposited on the outside of unopened buds.

[1] *Heliothis niveicosta* Smith, 1906, Jour. N. Y. ent. Soc., 14: 15.

Rearing techniques employed were those outlined by Hardwick (1958). Of larvae reared at room temperature, 94% matured in six stadia, the remainder in five. The latter have been ignored in subsequent descriptions of larval stages. The newly hatched larva bores into the base of a floret, then tunnels up through the floral tube, feeding on the contents. The larva commonly remains within one floret throughout the first and second stadia. In the third stadium, the larva usually enters a second floret. Larger third stadium larvae are unable to contain themselves within a single floret, and must feed from a position among the florets within the head. During the third stadium, larvae occasionally show a tendency to begin feeding on the developing seeds; in the fourth stadium, both seeds and florets are consumed. Occasionally in the fourth stadium, and commonly in the fifth stadium, the larva moves from the first flowering head, which has become heavily cluttered with frass, to a second, fresh head. During the latter part of the fifth stadium and throughout the sixth stadium, the larva ceases to secrete itself within the head and feeds on it from a position on the stem. Larger larvae are primarily nocturnal, most of them hiding at the base of the plant during the day. The larva tunnels into the soil to pupate.

DESCRIPTION OF STAGES

ADULT (Figs. 1, 2). Vestiture of head and thorax pale creamy gray, that of abdomen usually darker. *Forewing* creamy white, variably suffused with pink or pale purple and with olive gray. A creamy white costal band extending from base to subterminal line. Transverse anterior line unexpressed; basal and median spaces fused. Transverse posterior line closer than usual to outer margin of wing, weakly excurved around cell, then straight or weakly excurved to trailing margin. Orbicular spot absent. Reniform spot indicated only as a dark gray shade. A dark pink or pale purple streak extending from base almost to center of wing. Area distal to basal streak and posterior to reniform spot usually suffused with olive gray. Commonly a pink or dull purple shade extending from basal streak to subterminal space. Subterminal line indicated only by color change between subterminal and terminal spaces. Subterminal space pink, dull purple, or pale purplish gray. Terminal space cream, variably suffused with pale olive gray. Fringe pale olive gray.

Hindwing white, with a variably defined, light brown discal spot. A pink or brown outer-marginal band and often a pink suffusion between discal spot and outer-marginal band. Veins in basal white area of wing often outlined by brown scales. Fringe white. *Underside*, forewing cream with a brown discal spot and a subterminal pink shade. Hindwing cream with a pink or light brown discal spot and often with some pink outer-marginal shading. Fringe of both wings cream.

Expanse: 24.4 ± 1.9 mm[2] (100 specimens).

EGG. Micropylar surface corrugated, remainder smooth. Pale greenish yellow when first deposited. Losing greenish tone on second day, then remaining essentially unchanged until fourth day when a pink or pale orange flush becomes evident at micropylar end. On fifth day, two definite brown spots evident on micropylar surface. Hatching on sixth day after deposition.

Dimensions: Length, 0.74 ± 0.03 mm; width, 0.48 ± 0.03 mm (20 eggs).

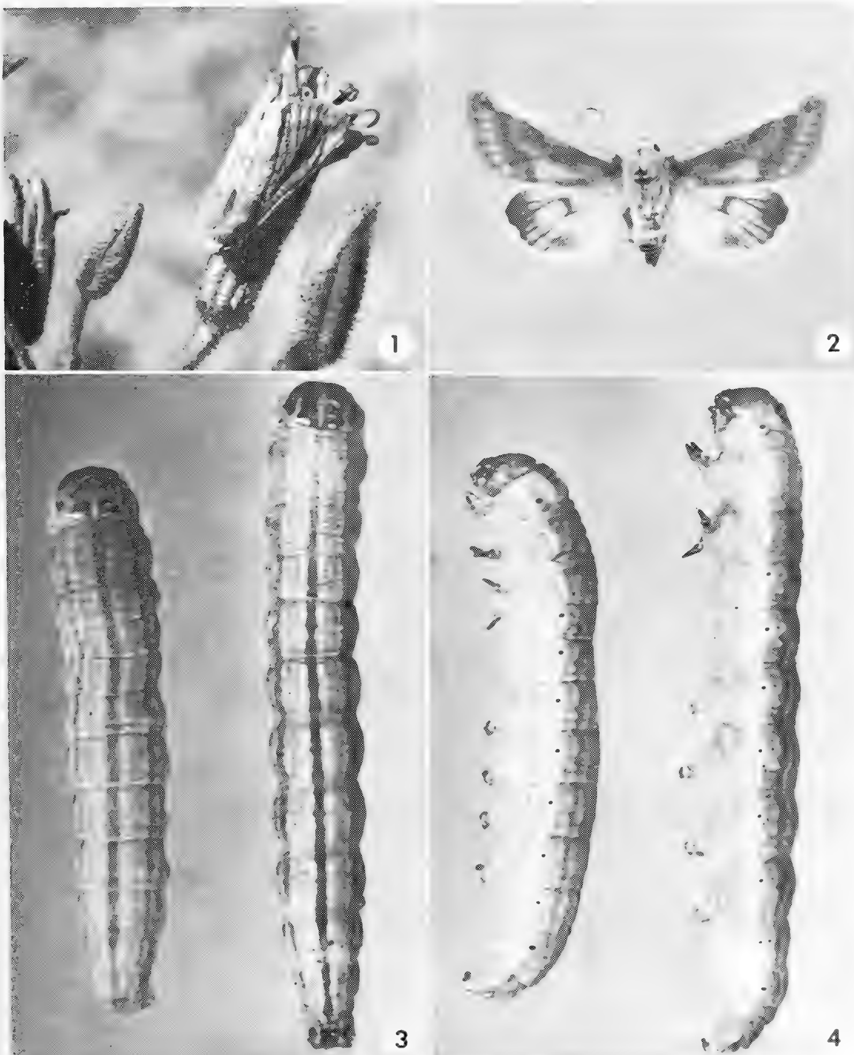
[2] Standard deviation.

First Stadium Larva. Head black. Prothoracic and suranal shields dark brown. Trunk pale whitish cream. Thoracic legs and rims of spiracles dark brown.

Head width: 0.29 ± 0.01 mm (20 larvae).

Duration of stadium (at room temperature): 4.1 ± 0.5 days (58 larvae).

Second Stadium Larva. Head medium brown, dark brown, or blackish brown. Prothoracic shield somewhat paler than head, with three pale longitudinal lines.



Explanation of Plate

Figs. 1–4. *Schinia niveicosta* (Sm.), La Quinta, Riverside Co., Calif. 1, Adult resting on blossom of *Palafoxia linearis* (Cav.) Lag. 2, Adult male. 3, Ultimate stadium larvae, dorsal. 4, Ultimate stadium larvae, lateral.

Suranal shield concolorous with prothoracic shield, with a pair of pale longitudinal lines. Trunk yellowish cream, with a pair of dorsal, and a pair of subdorsal, paler longitudinal lines. Spiracles with dark brown rims. Thoracic legs medium to dark brown.

Head width: 0.45 ± 0.03 mm (20 larvae).

Duration of stadium: 3.0 ± 0.8 days (58 larvae).

THIRD STADIUM LARVA. Head varying from pale fawn to medium grayish brown; variably, usually heavily, marked with dark brown. Prothoracic shield medium to dark grayish brown, with three broad, whitish gray longitudinal lines; often a pale blotch in median area of shield fusing median line with sublateral lines. Suranal shield concolorous with prothoracic shield, with a pair of grayish white sublateral longitudinal lines. Middorsal band yellowish fawn, orange–brown, or grayish brown. Subdorsal area with white, cream, or pale gray marginal lines, with a median band concolorous with, or somewhat paler than, middorsal band. Supraspiracular area concolorous with median band of subdorsal area; a prominent, somewhat irregular, cream, gray, or white median line. Spiracular band cream, white, or pale gray. Rims of spiracles brown. Suprapodal area gray, somewhat darker than spiracular band. Midventral area gray, paler than suprapodal area. Prolegs varying from fawn to dark blackish brown.

Head width: 0.76 ± 0.04 mm (20 larvae).

Duration of stadium: 3.0 ± 0.7 days (58 larvae).

FOURTH STADIUM LARVA. Head fawn to orange–brown, variably mottled with chocolate brown, frequently heavily so dorsolateral to apex of frons. Prothoracic shield yellowish gray to fawn, variably suffused with medium to dark chocolate brown; usually a median and a pair of sublateral, longitudinal pale lines. Suranal shield dark brown, with a pair of grayish yellow sublateral longitudinal lines. Middorsal band chocolate brown, purplish brown, reddish brown, or olive brown. Subdorsal area grayish white or cream, with a broad, brown or olive, median band. Supraspiracular area brown, or light green suffused with brown; an irregular grayish white median shade. Spiracular band white, occasionally margined ventrally by an irregular and discontinuous brown line. Rims of spiracles brown. Suprapodal area light smoky gray. Midventral area essentially concolorous with suprapodal area. Thoracic legs and proleg shields grayish fawn, variably mottled with chocolate brown.

Head width: 1.27 ± 0.09 mm (20 larvae).

Duration of stadium: 3.5 ± 0.7 days (57 larvae).

FIFTH STADIUM LARVA. Head pale orange fawn variably mottled with light fawn gray. Prothoracic shield pale orange fawn, variably, often heavily, suffused with brown; in heavily suffused shields, a median, and a pair of sublateral, longitudinal grayish white lines evident. Suranal shield grayish fawn, variably, usually heavily suffused with brown; a pair of grayish white, sublateral longitudinal lines. Middorsal band reddish brown or purplish brown, often with a greenish suffusion. Subdorsal area grayish white with a brown median band; median band paler than middorsal band, occasionally very pale or even evanescent. Supraspiracular area shades of pale brown, with an irregular whitish gray median line. Spiracular band white. Rims of spiracles dark brown. Suprapodal and midventral areas pale gray. Thoracic legs and proleg shields pale translucent fawn, lightly suffused with brown.

Head width: 1.98 ± 0.09 mm (20 larvae).

Duration of stadium: 3.8 ± 0.7 days (58 larvae).

SIXTH STADIUM LARVA (Figs. 3, 4). Head fawn gray variably mottled with light orange–brown. Prothoracic shield fawn gray suffused with chocolate brown; with a median and a pair of sublateral, white or pale cream, longitudinal lines. Middorsal band reddish brown or purplish brown. Subdorsal area white or pale cream, with a reddish brown median band; median band of subdorsal area usually much paler than middorsal band. Supraspiracular area pale reddish brown; in more darkly pigmented

specimens, supraspiracular area with an irregular, white or pale cream median line. Spiracular band white or pale cream. Rims of spiracles black. Suprapodal and midventral areas shades of gray or fawn gray. In pale specimens, ventral area of trunk undistinguished from spiracular band. Thoracic legs gray or fawn gray, variably suffused with pale orange. Proleg shields paler than thoracic legs.

Head width: 2.83 ± 0.12 mm (18 larvae).

Duration of feeding phase of sixth stadium: 4.4 ± 1.4 days (58 larvae).

Duration of prepupal phase of sixth stadium: 3.3 ± 1.1 days (15 larvae).

Pupa. Moderately dark orange–brown. Spiracles weakly projecting above general surface of cuticle. Anterior areas of abdominal segments 5, 6, and 7 moderately pitted. Cremaster without spines, consisting only of a truncated protuberance projecting from apex of tenth abdominal segment (Figs. 5, 6).

Length to posterior margin of fourth abdominal segment: 8.7 ± 0.5 mm (20 pupae).

Acknowledgment

I am grateful to Mr. John E. H. Martin, Entomology Research Institute, Ottawa, for photographing adults and larvae in the field.

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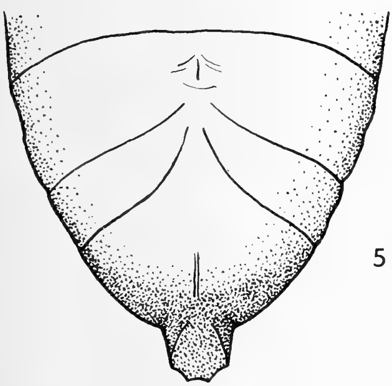

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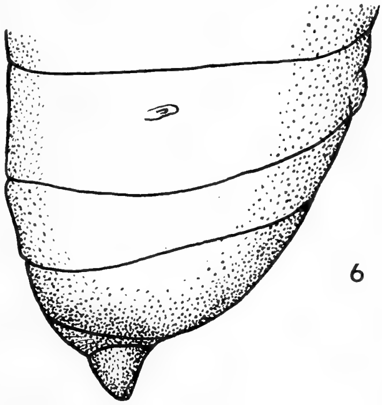

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Explanation of Figures

Figs. 5, 6. *Schinia niveicosta* (Sm.), apical abdominal segments of pupa. 5, Ventral. 6, Right lateral.

BOOK NOTICE

NICULESCU, EUGEN V.: Pieridae. Fauna Republicii Populare Romane, vol. XI, fasc. 6, 202 pp., 13 pls., 66 figs. (In Rumanian). Bucharest 1963. Price 13,- Lei. Nymphalidae. Fauna Republicii Populare Romane, vol. XI, fasc. 7, 361 pp., 25 pls., 160 figs. (In Rumanian). Bucharest 1965. Price 29,- Lei.

Further volumes of the series "Fauna of Rumania" treat the white butterflies and Nymphalid butterflies of that country. Fascide 6 (Pieridae) records eight genera with 18 species, which are described in detail. The taxonomic part contains descriptions of all stages.

The species *Colias australis* Vty. is recorded as a form of *Colias hyale* L. *Pieris bryoniae* O. is discussed as a subspecies of *Pieris napi* L.

In Rumania 44 species of the family Nymphalidae are recorded. In the introduction the author gives a short review of morphology and geographical distribution of this family. The immature stages, distribution, and variability of all species are discussed in more detail. Important are the morphological notes with good drawings. All species and some forms are figured in plates as black and white photographs.

Both books are of interest for all students of European butterflies.—J. MOUCHA, *Prague, Czechoslovakia*

FIRST MINNESOTA RECORDS OF *THORYBES BATHYLLUS*

Although recent popular literature lists the distribution of the southern cloudy wing, *Thorybes bathyllus* (Smith) (Hesperiidae), as westward to Wisconsin (Milwaukee) and Nebraska, Macy and Shepard (1941)[1] do not cite any records for Minnesota. The southeastern corner of Minnesota, which is typically pseudo-Carolinian in its flora and fauna, provides good habitats for numerous "southern" species of butterflies. Unfortunately, a general lack of collectors has left us with very little knowledge of that area.

Recently, Ray Glassel donated to me the bulk of his butterfly collection and among these was a single specimen of *Thorybes bathyllus*, taken by him near Cedar Grove, Dakota County, Minnesota on 4 July 1960. I thought this to be the first Minnesota record, but a check of the University of Minnesota collection revealed one earlier specimen, taken at Mississippi Bluff, Houston County on 31 May 1942 by Morris Rockstein. Still another record appeared in the Season Summary (Lepidopterists' News, 1963, No. 4: 8); a specimen was reported from Houston County, Minnesota, taken on 30 June 1962.

These are the only known Minnesota specimens to date. Further collecting will probably find *T. bathyllus* in most of the southeastern corner of Minnesota where two of its foodplant species of Fabaceae, trailing wild bean (*Strophostyles helveola*), and small wild bean (*Strophostyles leiosperma*) are found.

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[1] Ralph W. Macy & Harold H. Shepard, *Butterflies* (Minneapolis: University of Minnesota Press, 1941), p. 184–185.

LARVAL FOOD PLANTS FOR FIVE TEXAS HESPERIIDAE

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This paper will record for the first time local larval food plants for *Vidius perigenes* Godman, *Erynnis juvenalis juvenalis* (Fabricius), *Cogia calchas* (Herrich-Schäffer), and *Urbanus procne* (Plötz). Although local larval food plants have been previously recorded for *Chioides catillus albofasciatus* (Hewitson), additional rearing data are given here in support of a larval diapause for the species. Arrangement for the skippers follows dos Passos (1964).

Of the larval food plants given, perhaps the most significant is the one for *Urbanus procne*. Burns (1964, p. 148) represented all contemporary lepidopterists when he wrote: "the larvae of pyrgine skippers are known to eat only dicotyledons." We must now change our thinking on this matter because the larvae of *U. procne* do eat grass, a monocotyledon. No doubt other members of this genus will be found to feed on grasses in the larval stage.

The larval food plants given in this paper are here summarized and arranged alphabetically by plant family and genus:

Plant Family	Plant Species	Lepidoptera
Fagaceae	*Quercus fusiformis*	*Erynnis j. juvenalis*
	Quercus stellata	*Erynnis j. juvenalis*
	Quercus marilandica	*Erynnis j. juvenalis*
Gramineae	*Cynodon dactylon*	*Urbanus procne*
	Stenotaphrum secundatum	*Vidius perigenes*
Leguminosae	*Mimosa berlandieri*	*Cogia calchas*
	Rhynchosia minima	*Chioides c. albofasciatus*

Vidius perigenes Godman

Tilden (1964) recorded this species for the first time north of the Rio Grande River. At present its distribution in the United States north of Mexico is limited to Cameron County, Texas, where it is well established. Its principal habitat appears to be grassy areas in mesquite flats (*Prosopis glandulosa* Torr.) along the south Texas plains. Three broods with some overlapping are indicated. The writer has collected it in March, April, and October; reared imagines emerged in June. Exact dates and localities follow.

Cameron County, 21 April 1962. At the Laguna Atascosa National Wildlife Refuge, two males and one female were collected. The latter was kept for oviposition. It was confined in a small glass jar with St. Augustine grass, *Stenotaphrum secundatum* (Walt.) Kuntze. Six eggs were deposited the following day on the grass, after which the female died, probably due to overheating. The eggs hatched within a few days and the first-instar larvae accepted *S. secundatum* reluctantly. Three larvae pupated:

1, 4, and 7 June and adults emerged 9 June (1 ♂), 13 June (1 ♂), and 17 June (1 ♀).

On 28 March 1964 at a roadside park on Texas Highway 100 about 3.5 miles east of Los Fresnos, two males and three females were collected. One of the females was kept alive, and eggs were deposited on S. *secundatum*. This occurred at the beginning of a two-week field trip; the eggs hatched and the first-instar larvae were lost before returning to the laboratory.

Other collections of this species in the county by the writer and Mrs. Kendall are: October 17, 1963 at Brownsville (1 ♂, 1 ♀); March 29, 1964 on FM 1792 near Port Isabel (3 ♂). Special attention was not given to collecting this species.

Erynnis juvenalis juvenalis (Fabricius)

Burns (1964) indicated that *E. j. juvenalis* was strictly or essentially univoltine in Texas. Recent rearing records confirm these findings. Locally, *juvenalis* flies from early March to early May, with an occasional abnormally rapid development of immatures which produce adults later in the same year. Specimens reared from eggs at San Antonio, in an outdoor environment, except for one, produced imagines in March of the following year. This one larva matured early in the same season. It is doubtful that sufficient numbers of both sexes are produced in nature to establish a second brood.

Larval feeding continues over a period of 6 to 8 months depending upon the geographical location, after which the larva enters diapause. Judging from the reared sample, this species spends about 4 to 6 weeks in larval diapause and about the same length of time in the pupal stage.

In Texas *juvenalis* is less common than *Erynnis horatius* (Scudder & Burgess). This is attributed to the single brood and long larval period of *juvenalis*, which makes it more susceptible to predation and parasitism. Like *horatius*, adults of *juvenalis* are found associated with oaks, the larval food plant. Juvenile leaves are essential for first-instar larval development. Females deposit their eggs on or near juvenile leaves only, and it matters not whether the plant is a 6-inch seedling or a 30-foot tree.

Harrison County, 4 April 1964. At Caddo Lake State Park, a female was collected as it was about to oviposit on the juvenile leaves of a 5-foot *Quercus marilandica* Muenchh. A number of eggs were obtained by confining the female in a jar with terminal shoots of *Q. marilandica*. These eggs started hatching 13 April; others were preserved. On 30 April, five larvae were inventoried; by 10 August, four had died. The remaining larva was then preserved. Death was attributed to confinement of the larvae in closed rearing jars.

Kerr County, 4 April 1965. On FM 689 near Camp Verde, three males and three females were collected while they were feeding on blossoms of redbud, *Cercis canadensis* L. var. *texensis* (Wats.) Rose. One female was kept for oviposition. After depositing three eggs, she escaped. At the time of this writing (April, 1965) the three larvae were alive and feeding on *Quercus virginiana* Mill. var. *fusiformis* (Small) Sarg.

Polk County, 3 April 1964. On Nettles Cemetery road east of Livingston, a female was observed to oviposit on juvenile leaves of *Q. marilandica*. This oak was about 20 feet tall and the egg-laying female was out of reach; however, three eggs were recovered from twigs of one branch. These eggs soon hatched but were lost due to improper care in the field. Near this location on 16 March 1963, Kendall (1964) found numerous males flying but no females. This would indicate that females generally emerge later than the males.

Smith County, 4 April 1964. At Tyler State Park two females were observed to oviposit on oak. One deposited an egg on juvenile leaves of a 5-foot *Q. marilandica* bush about 3 feet above the ground. The other one deposited an egg on a 6-inch seedling of *Quercus stellata* Wang. Both were collected. The latter female was placed in a jar with the same seedling; 32 eggs were deposited the following day. Eggs started hatching 13 April and newly hatched larvae were offered juvenile leaves of *Q. fusiformis*, which they accepted. On 30 April an inventory disclosed 25 larvae, two of which were dead. On 11 May an inventory disclosed four more had died, leaving only 19. Two larvae were then preserved, and those remaining were placed on a caged living *Q. fusiformis* bush in the laboratory garden at San Antonio. Cursory periodic examinations thereafter disclosed larvae to be doing fine. On 2 September a shelter was opened for examination, revealing an empty pupal case; the adult was nowhere to be found, and the exact date of pupation and emergence was therefore unknown. Probably it had emerged sometime earlier, died, and ants had eaten it.

On 13 September all larvae appeared to be feeding. On 15 November one larva appeared to be in diapause. Examination on 22 January 1965 disclosed 3 dead larvae, four more in diapause, and seven pupae, one of which had been killed by a predator. The four live larvae were then removed and placed in a small container for close observation. One larva escaped. Two others pupated 29 January and 6 February, respectively; the fourth died. Four males and four females emerged: 1 March (♂), 14 March (2 ♂, 1 ♀), 15 March (♀), 16 March (♀), 23 March (♂) (this one pupated 29 January), 29 March (♀).

One interesting development occurred on March 14 when one of the males escaped from its emergence container and was flying about inside a screened walk-in cage. As Mrs. Kendall and the writer watched, the insect chanced to light near a chameleon lizard which had gained entrance to the large breeding cage, and was immediately caught and swallowed.

The writer and Mrs. Kendall have collected *E. j. juvenalis* in the following Texas counties not previously recorded: Brown Co., Lake Brownwood State Park, 9 April 1964 (2 ♂, 1 ♀), 10 April 1964 (2 ♀); Cass Co., near Avinger, 6 April 1964, (1 ♀); Fannin Co., Bonham State Park, 7 April 1964 (2 ♂, 2 ♀); Kendall Co., 7 mi SE of Comfort, 4 April 1965 (1 ♂); Tarrant Co., Fort Worth city park, 8 April, 1964 (3 ♂, 5 ♀).

Cogia calchas (Herrich-Schäffer)

The distribution of the calchas skipper in Texas seems to be limited to Cameron and Hidalgo counties, correlating highly with the distribution of its local larval food plant, *Mimosa pigra* L. var. *berlandieri* (Gray) (Turner, 1959). This insect has been field collected from March to November. Reared specimens emerged in January, February, March, July,

August, and September. It has a larval diapause and therefore would not normally emerge in nature during January or February when its larval food plant is dormant. It appears to be triple-brooded.

Larval habits compare favorably with those of *Cogia hippalus outis* (Skinner) as described by Kendall (1965). The mature larva vacates its growing leaf shelter and constructs another on the ground under leaf litter and debris where it pupates.

Cameron County, 18 July 1964. In Brownsville, while the writer was collecting eggs and larvae from a 6-foot *M. berlandieri* plant growing in the edge of water, a female came and deposited an egg on a terminal leaflet of the plant being examined. The captured female died before reaching the laboratory. Two more ovipositing females were seen the same day but could not be collected. Several eggs and 28 larvae were collected in an hour or so. All the eggs and a small series of larvae and pupae were preserved. The remaining larvae were reared on *M. berlandieri.* Pupation occurred from 19 July to 19 August. Ten males and five females emerged: 28 July (♀), 31 July (♂), 3 Aug. (♀), 5 Aug. (1 ♂, 1 ♀), 6 Aug. (♂), 7 Aug. (2 ♂), 8 Aug. (♂), 10 Aug. (♂), 23 Aug. (1 ♂, 1 ♀), 28 Aug. (♂), 31 Aug. (1 ♂, 1 ♀).

The Brownsville area was revisited on 22 August 1964 and four more larvae were found on *M. berlandieri.* One larva died and the other three pupated 25, 26, and 28 August. Adults emerged: 3 Sept. (♀), 4 Sept. (♂), and 7 Sept. (♂).

On 4 December 1964, at a state-operated wildlife management area near Brownsville, three eggs and 19 larvae were collected on *M. berlandieri.* Three larvae and the eggs were given to Norman E. Flitters of Brownsville for study. The first of the remaining larvae pupated 22 December; the others were unobserved. A few died and several entered larval diapause. The immatures were kept under semicontrolled laboratory conditions with the result that most of them produced adults prematurely. Two males and six females emerged: 12 Jan. 1965 (♀), 13 Jan. (♀), 31 Jan. (♀), 6 Feb. (♂), 11 Feb. (♂), 14 Feb. (♀), 10 Mar. (♀), and 29 Mar. (♀). In nature, overwintering immatures should produce adults beginning about the middle of March.

The writer and Mrs. Kendall collected other adults in Cameron County on 17 Oct. 1963 (2 ♂), 19 Oct. 1963 (3 ♂), 29 March 1964 (1 ♀), and 18 July 1964 (1 ♂, 1 ♀). Freeman (1949 and 1951) recorded it from Cameron County in June, August, and October, and in Hidalgo County in March, May, June, August, September, and October. He also gave the writer a male collected 7 April 1945.

Urbanus procne (Plötz)

Neither the distribution of *U. procne* in Texas nor the factors influencing its distribution are well understood. The principal habitat of this species seems to be extreme south Texas where it is perhaps triple-brooded, with considerable overlapping. It has been collected in March, June, July, August, October, November, and early December. Reared adults emerged in August, September, and October.

It will come as a surprise to most students of the Pyrginae to learn that the larva of this insect is a grass-feeder. Other species of this genus may

also feed on monocotyledons. One of its most interesting larval habits is that a nest or shelter is not made until the larva is fully mature and then only as a place to pupate. When not feeding it hides in the grass near the ground. When ready to pupate, it constructs a shelter from grass litter and silk on the ground at the base of the clumps. Further research is necessary to determine whether or not an immature diapause occurs. Determination of the imagines was made by Dr. J. W. Tilden (1965).

Cameron County Texas, 19 July 1964. In Brownsville along the banks of a resaca, two ovipositing females were collected and eggs recovered from a species of grass not yet determined. Later in the day at another location in the city, two more females were collected as they oviposited on two other species of grass, one of which was Bermuda, *Cynodon dactylon* L. All four females were kept alive for additional oviposition. They were placed in separate containers and labeled A, B, C, and D. Eggs were deposited by each in the laboratory as follows: Female A, on *C. dactylon*, 19 July (1), 20 July (22), 21 July (5), female died same day. Female B, on *C. dactylon*, 19 July (1), 20 July (40), 21 July(9), 22 July (2); on *Stenotaphrum secundatum* (Walt.) Kuntze, 24 July (10), 25 July (62), 26 July (43), female died the same day. Female C, on *C. dactylon*, 19 July (1), 22 July (2); on *S. secundatum*, 24 July (4), 25 July (7), 26 July (15); it then died. Female D, on *C. dactylon*, 19 July (1), 20 July (11), 21 July (3); it then died.

Eggs hatched from 22 July to 31 July. First-instar larvae were offered *C. dactylon*, *S. secundatum*, and *Sorghum halepense* (L.) Pers. Only those on the *C. dactylon* survived. Where *S. secundatum* was mixed with *C. dactylon* only the latter was eaten. After progressing through five instars, the first larva pupated 19 August and the last one on 17 September. Examples of all immature stages were preserved. Adults emerged: 28 Aug. (1 ♂), 29 Aug. (2 ♂, 1 ♀), 31 Aug. (2 ♂, 1 ♀), 1 Sept. (3 ♂, 1 ♀), 2 Sept. (1 ♀), 3 Sept. (3 ♂), 4 Sept. (1 ♀), 7 Sept. (1 ♂, 1 ♀), 8 Sept. (1 ♂), 9 Sept. (1 ♀), 13 Sept. (1 ♂), 14 Sept. (1 ♂), for a total of 15 ♂ ♂, 7 ♀ ♀.

On a return trip to Brownsville two females were collected 22 August 1964. One of these deposited a few eggs in the laboratory on *C. dactylon*. The eggs soon hatched and the larvae crawled away unobserved except for two; one of these died later. The one remaining larva matured on *C. dactylon*; it pupated 25 September and a female emerged 7 October 1964.

Other Texas collection records by the writer and Mrs. Kendall are: Bexar County, 10 June 1956 (1 ♂); Cameron County, 17–18 Oct. 1963, common, 29 March 1964 (1 ♂), 21 Aug. 1964 (1 ♂, 3 ♀), 4 Dec. 1964 (1 ♀). Dr. J. W. Tilden (1965; in litt.) found *U. procne* common in Cameron County 17–30 Oct. and 11–13 Nov. 1963. In Hidalgo County he collected two worn males on 11 Nov. 1963.

Chioides catillus albofasciatus (Hewitson)

Kendall (1965) stated that an immature diapause was not indicated for this species. Additional rearing has shown that *C. albofasciatus* does have a larval diapause.

Cameron County Texas, 21 August 1964. At Brownsville a few adults were found flying; one female was collected and kept for eggs. It was confined in a glass jar with *Rhynchosia minima* (L.) DC., and numerous eggs were deposited during the next several days. When the eggs hatched, the first-instar larvae were placed on a caged living plant of *R. minima* in the laboratory garden at San Antonio. Only cursory examinations were made thereafter until two males appeared in the cage on 20 September. The cage was then removed and a thorough examination made with the result that 48 pupae, mostly on the ground under fallen leaves, and 16 larvae were found. Of these, five pupae and three larvae, ready to pupate, were sent to Dr. C. L. Remington for chromosome study. Ten of the larvae pupated: 27 Sept. (3), 29 Sept. (4), 30 Sept. (1), and 1 Oct. (2). This left three larvae which stopped feeding 17 October and entered diapause. They were placed outdoors in a screened cage on the ground and covered with dried leaves on 30 October. Periodic examinations disclosed that two of these larvae pupated about 21 February; the third larva died. From these pupae, males emerged on 8 and 10 March 1965.

Other adults from the same parent emerged: 30 Sept. (1 ♂), 1 Oct. (1 ♂), 2 Oct. (3 ♂), 3 Oct. (4 ♂, 2 ♀), 4 Oct. (7 ♂, 2 ♀), 5 Oct. (2 ♂, 2 ♀), 6 Oct. (3 ♂, 3 ♀), 7 Oct. (1 ♂), 8 Oct. (4 ♂, 2 ♀), 9 Oct. (2 ♀), 11 Oct. (1 ♂, 2 ♀), 12 Oct. (2 ♂, 1 ♀), 13 Oct. (1 ♂, 2 ♀), 14 Oct. (1 ♀), 15 Oct. (2 ♀), 17 Oct. (1 ♀), 18 Oct. (1 ♀), 20 Oct. (1 ♂), for a total of 31 ♂ ♂, 23 ♀ ♀.

A return visit to Brownsville was made on December 4 and 5, 1965. Two males were collected and numerous first- and second-instar larvae were found on *R. minima* growing along an irrigation canal. Only four larvae were collected because the food plant in the laboratory garden at San Antonio was already largely defoliated due to the advance of winter. A frost killed all the remaining food plant about December 15. One larva, very small, pupated January 1, 1965; the other three were preserved. On January 24 a dwarfed female emerged; the larva and pupa had been kept in the laboratory at all times.

These additional studies show the significance climate has on the distribution of *C. albofasciatus*. Except for extreme south Texas, this species cannot become established because too few larvae from the summer broods enter diapause and, secondly, because the average early date of the first freeze in the fall (Hildreth & Orton, 1963) kills the larval food plant, causing the immatures to die of starvation. Only under ideal climatological conditions could this species survive for more than one season as far north as Bexar County, Texas. Such a period existed from 1957 to 1959 (Kendall, 1965).

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OCCURRENCE OF *CALLOPHRYS ERYPHON* (LYCAENIDAE) IN MICHIGAN

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For some time now, the record of *Callophrys eryphon* (Boisduval) from Michigan has been in doubt. Specimens representing this record have been assumed by many lepidopterists to fall within the usual *C. niphon* (Huebner) variation. Moore (1960) listed *eryphon* from Mackinac County, referring to two specimens collected on May 18, 30, one near St. Ignace and the other near Naubinway; however, the specimens were never positively determined to represent this hairstreak.

Recently, while examining butterflies in the collection at Northern Michigan College, I found a specimen in their *Callophrys niphon* series that strongly resembled *eryphon*, and it had been collected in Marquette County. Then on May 16, 1964, I collected four specimens in Chippewa and Luce counties (in the eastern Upper Peninsula) which fitted the description of *eryphon*. The specimens from Chippewa, Luce, and Marquette counties were subsequently examined by Harry K. Clench of the Carnegie Museum and found to be *C. eryphon*. The following is a quote from Clench's letter of September 16, 1964:

"The *eryphon* are . . . perfectly good *eryphon* though a little peculiar: they run slightly smaller; the females are more extensively fulvous above (but are nicely matched in this by a series from Moffat County, Colorado); and on the underside there is a tendency towards an increased suffusion of hoary gray scaling in the terminal spots of the hind wing, faintly reminiscent of the condition typical of *niphon*. All of these traits are exceedingly slight, however, and there is certainly no reason at this time to even think of separating them as a different subspecies."

The Marquette specimen is a slightly torn female taken by Richard L. Lake on May 22, 1960, a few blocks from the campus of Northern Michigan College within the city of Marquette—Township 49 North, Range 25 West, Section 10. This specimen is now in the writer's collection.

The Chippewa County specimens are two fresh females collected in company with females of *C. niphon clarki* (Freeman) (determined by H. Clench) and *C. augustinus* (Kirby) while sunning on a sandy road on

May 16 at 10:00 to 11:00 A.M. in Township 45 North, Range 5 West, Section 36. This road separates a large sphagnum-heath bog from an upland area of mixed pine and miscellaneous hardwoods and shrubs. Jack, red, and white pines (*Pinus banksiana, resinosa,* and *strobus,* respectively) were found in this vicinity, all possible foodplants for both *eryphon* and *niphon.*

In Luce County, the *eryphon* specimens, two fine males, were collected later in the day on May 16, resting on sedges in a small opening within old growth hardwoods less than a mile north of Tahquamenon Falls in Township 48 North, Range 8 West, Section 1. A few white pines, seedlings, and mature trees, were noted in the perimeter of this opening—representing a possible foodplant. Other species taken here with *eryphon* were *Celastrina argiolus pseudargiolus* (Boisduval & Le Conte) (fresh) and *Vanessa virginiensis* (Drury).

It is extremely interesting to find this western species in Michigan and to find it strictly sympatric with its very near relative, *niphon,* in the Upper Peninsula. Klots (1951) does not list *eryphon,* nor refer to it in his list of casual species, as occurring east of the Great Plains. In Ehrlich & Ehrlich (1961), Clench cites Nebraska and northern Manitoba as the eastern limit of *eryphon.* It would therefore appear that these records represent a considerable eastward range extension of *eryphon* in North America. Additional observations and collections will be necessary to determine to what extent *C. eryphon* is permanently established in Michigan's Upper Peninsula and to what extent it can coexist with *niphon* in the same habitat. I strongly urge collectors in Ontario and the northern Lake States to reexamine their *niphon* series for the possibility of masquerading *eryphon* specimens. All doubtful material can be forwarded to Harry Clench for critical examination.

Acknowledgments

I would like to thank Dr. Gordon D. Gill, Department of Biology, Northern Michigan College, for permitting me to examine the butterfly collection from that institution and for providing information relative to the Marquette *eryphon.* Also, my sincere appreciation is extended to Harry K. Clench for his examination and verification of the *Callophrys* specimens, and for reviewing the manuscript and suggesting helpful comments.

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REDISCOVERY OF *EUPTYCHIA MITCHELLII* (SATYRIDAE) IN NEW JERSEY

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The most recent guidebooks (Ehrlich & Ehrlich, 1961: 91; Forbes, 1960: 169; Klots, 1951: 69–70) either question or ignore old records of *Euptychia mitchellii* (French) from New Jersey. This is not surprising, because these ambiguous records ("Dover, Woodport," "near Lake Hopatcong") seem to have been based on a single specimen which vanished long ago (Engelhardt, 1936: 110), and the butterfly was not found in New Jersey since the 1890's despite careful search by experienced lepidopterists (McAlpine *et al.*, 1960: 211).

The unpromising history of this species made me feel singularly lucky in mid-July, 1963, when I found a colony of *mitchellii* in a favorite swamp near Newton, Sussex County, in northern New Jersey. I say "favorite" because this swamp offers a variety of wet habitats, all the way from a little acid bog to an alder thicket. Even more conveniently, it is traced with paths and footbridges, and seems free of poison sumac. In this New Jersey locality the butterflies tend to fly "along very narrow grassy strips bordering small watercourses," as McAlpine (1936: 221) reported of the Michigan colonies.

Badger (1958: 46) has indicated that *mitchellii* populations seem prone to yearly fluctuation. During the two seasons that I have watched the New Jersey colony, the population has fluctuated from sparse (1963: about two dozen individuals seen at peak) to almost nonexistent (1964: only five or six stragglers found despite diligent search throughout July). Everyone seems agreed that *mitchellii* is easy to overlook. Perhaps its specialized habitat, which is repellent to the collector, to say nothing of its brief flight period and inconspicuous appearance, protects it from discovery in many places where it occurs. A sharp-eyed collector must chance to be in the proper spot during the right few days in a year of peak abundance.

Through the courtesy of Dr. F. H. Rindge, I was permitted to compare my material with the *mitchellii* series (from the type locality at Wakelee, Michigan, and from Streetsboro, Ohio) in the collection of the American Museum of Natural History. My New Jersey specimens, some of which have been deposited in that collection, did not show any consistent difference, nor did they blend into a series of *E. areolata septentrionalis* (Davis) from its type locality at Lakehurst, Ocean County, in central New Jersey.

It appears that the location of the New Jersey colony of *mitchellii*, in the same part of the state as the old "Dover–Woodport–Lake Hopatcong" records, would make unlikely the possibility suggested by McAlpine *et al.* (1960: 210) "that the isolated New Jersey records of *mitchellii* . . . might have been based on specimens of *E. a. septentrionalis* showing extreme variation in the direction of *mitchellii*, or even . . . that *mitchellii* is a well defined subspecies of *areolata*." But Newton is a long way from the railroad station at Lakehurst (Klots, 1951: 70), and the distribution of *mitchelli* is still not clearly understood. It would be interesting to examine specimens from the still-undiscovered colonies in Pennsylvania and central New Jersey which may await the enterprising or the lucky collector.

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SPEYERIA CYBELE (NYMPHALIDAE) AT LIGHT

At 1:15 A.M. on August 5, 1965, I was surprised to find a fresh male *Speyeria cybele* (Fabricius) actively fluttering against a lighted window of my home in West Acton, Middlesex County, Massachusetts. The temperature was about 60° F., and there were numerous other Lepidoptera, mostly Geometridae such as *Itame pustularia* Guenée and *Semiothisa granitata* Guenée, at the window. Since there is a flower garden where this butterfly is a frequent visitor just outside, and since the house and garden are surrounded by fairly heavy pine woods, it is probable that the specimen was disturbed from its evening resting place, rather than coming any great distance to the light.

The only other record I have been able to find of *Speyeria cybele* at light is that cited in Kimball, *Lepidoptera of Florida*, 1965, p. 40.

CHARLES G. OLIVER, *West Acton, Massachusetts*

SOME EXPERIMENTAL COLOR ABERRATIONS IN *DANAUS PLEXIPPUS*

Jo Brewer
1090 Walnut St., Newton Highlands, Massachusetts

During the summer of 1964 we conducted a pilot rearing project in which 114 larvae of *Danaus plexippus* (L.) were reared under controlled light conditions in three cages, 38 in each cage. Light was provided by G.E. fluorescent lamps in combination with Rosco gelatine filters to produce the spectral energy distribution and input shown in the figure. The cages were painted with nonselective, nontoxic Pittsburgh white paint. The temperature within the cages ranged from 69° to 80°, while the temperatures outside for the same period ranged from 45° to 90°. The experiments were conducted in a completely darkened underground room which was notably humid. Humidity, however, was not measured. The purpose of the experiment was to study the effects of specific light upon the complete metamorphosis of this insect. Each cage was given 14 hours of light and 10 hours of darkness in each 24-hour period.

The first six larvae were found in the field in Walpole, Massachusetts, on May 31 and installed, two in each cage, while in the first and second instars. Of these, one in each cage survived. Cage 1 ("Blue," spectral energy: 4,000–5,000 angstroms) and cage 3 ("Red," 6,000–7,000 angstroms) produced color aberrations. The color of the scaling of the underside of both wings was normal, but on the upperside of the forewings the orange scales were fewer and paler than usual, the apex showing almost no orange. The overall effect was of a monarch with buff-colored hindwings and blue–black forewings with some dusky orange. The insect in cage 2 ("Green," 5,000–6,000 angstroms), although not brightly colored, was fairly normal. All three insects were females.

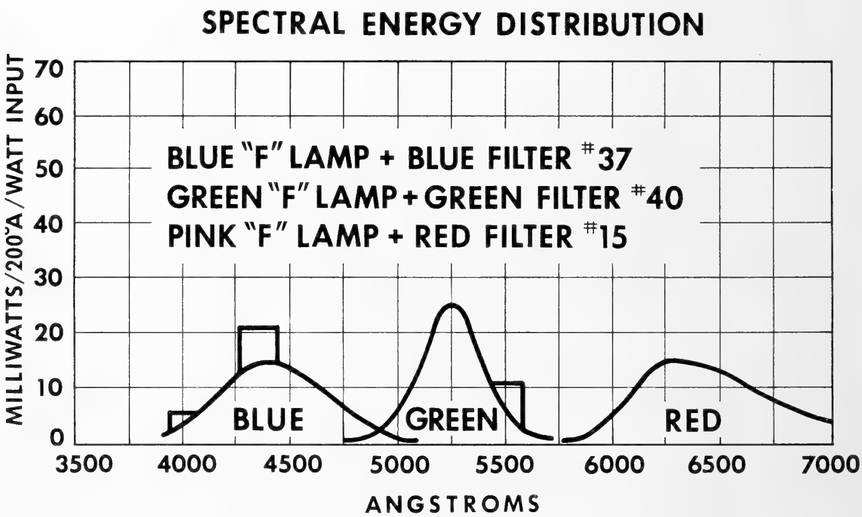
The next three larvae were also found in the field, in Bennington, Vermont, in the first and second instars, and were installed in the cages on June 20. These emerged on July 7–10, and produced two females and one male. All were of normal color. The male mated with both females, and a total of 884 eggs resulted. Of these, 105 were installed, 35 in each cage. The distribution was as follows.

	Eggs	*Female*	*July*
In each cage,	10	1	15
	5	2	18
	10	2	20
	10	2	23

Controls,	30	1	16
	71	2	18
	91	2	20
	74	2	23

The controls were reared in separate cages according to day of oviposition.

Of the 30 eggs which reached maturity in the cages, four resulted in color aberrations. Cages 1 and 3 each produced another butterfly with dark forewings and light hindwings. Cage 2 produced two insects in which both forewing and hindwings were buff-colored. All were females.



In the control group, kept under normal conditions of light and heat, 93 of the original 215 emerged with no color aberrations. In brief, the only color aberrations came from the light-controlled cages. They were offspring of three different females and two different males. They may have been genetic mutations. There are two specimens somewhat similar in the Andrew J. Weeks collection of Lepidoptera at the Museum of Comparative Zoology, Harvard, both taken around 1900. However, in the course of rearing and banding during eight years I have never seen another living monarch with colors even approaching those mentioned above. It seems plausible that a lack of certain qualities of light, a lack of total light energy, a lack of stimulation provided by sharply rising and falling temperatures, or a combination of all three factors may have contributed to the alteration of wing scale color. No conclusions can be drawn until the experiment has been repeated with tighter controls, but

in the meantime I have some rather strange-looking monarch specimens.

Acknowledgment is made to R. L. Paugh, Specialist, Plant Growth Lighting, General Electric Company, Cleveland, Ohio, who provided the spectral energy distribution graph.

THE TERMINATION OF SATURNIIDS' DIAPAUSE

Colleen Seeley
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Each spring for five years I have been forcing moths to emerge from their cocoons months before their normal time by bringing them into a warm room, spraying them with water, and wishing they would emerge. Last fall, 1964, because I had several hundred cocoons that I had produced through rearing during the summer, I decided to find out just what factor, or combination of things, made moths emerge. I also wanted to know exactly how long it took.

I set up the experiment by checking the time of the year when saturniids normally terminate their diapause, to see what conditions ordinarily exist at that time.

I used *Antheraea polyphemus* (Cramer), *Hyalophora cecropia* (L.), *H. gloveri* (Strecker),[1] and *Callosamia promethea* (Drury). These emerge the last two weeks in June, here in New York. At that time there is plenty of rain and the ground is damp, there are 17 hours of light, and the temperature ranges from 68° to 80° F. All these moths diapause in the pupal stage and would normally be exposed to several months of cold.

I ran two pretests on about 80 cocoons of 11 different saturniids, then set up the following tests on a more accurate basis.[2]

One hundred cocoons of the above four saturniids were divided into five groups of 20 cocoons each. All had been stored in the refrigerator for about five months. All were sprayed with water occasionally.

Group I: Cocoons were kept in darkness and temperature about 40° (in refrigerator). This group was my control. No moths emerged.

Group II: Cocoons were placed in an emergence box with a tight-fitted lid and taped to give total darkness, with the temperature 68°–75° F. Between the 20th and 30th day 85% emerged; 100% of the *cecropia*, *gloveri*, and *polyphemus* emerged. Over 50% emerged between 20 and 23 days.

Group III: Cocoons were placed in a screened box and given exactly

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[1] The *Hyalophora gloveri* stock originally came from North Dakota.

[2] Science Congress Project 1965, Albany Science Congress, Biology Intermediate Group—First Award, also Grand Prize.

17 hours of light from a 100-watt bulb each day.[3] The temperature was 68°–75° F. Between the 20th and 30th day 85% emerged; 100% of the *cecropia*, *gloveri*, and *polyphemus* emerged. Over 50% emerged between 27 and 30 days.

Group IV: Cocoons were placed in screened box with continuous artificial light from a 100-watt bulb. The temperature was 68°–75° F. Between the 20th and 30th day 90% emerged; 100% of the *cecropia*, *gloveri*, and *polyphemus*. Over 50% emerged between 22 and 25 days.

Group V: Cocoons were placed in a screened box, with only natural light, and in the basement where the temperature was below 65° F. None emerged.

It is unusual to have this high a percentage emerge in any experiment. Two prometheas were parasitized and others were still viable. They emerged four to six weeks later.

I conclude the key to the termination of saturniids diapause is temperature. Termination of saturniids diapause can be induced in 20 to 30 days by temperature 68°–75° F.

Other interesting information from the experiment:

(1) Total darkness or 24 hours of light sped up the termination slightly.

(2) Males emerged in the first part of the week, females in the latter.

(3) Half of the moths that emerged were males.

(4) Cocoons can be stored in temperatures under 65° F regardless of hours of light. Termination can be delayed with low temperatures.

(5) I found *cecropia*, *polyphemus*, and *gloveri* dependable subjects to work with.

These moths usually have a set time of the day to emerge. Moths emerging in total darkness or 24 hours of light emerged at odd hours. The *cecropia* were coming out at 10:00 P.M. and 9 to 10:00 A.M. They also mated at odd times. One male *cecropia* even copulated with a promethea. She deposited a few eggs (fertility unknown now).

This experiment held a surprise for me as I didn't expect to find any would emerge in the dark box. I might have expected it, though, because many shipments of moths have emerged in tight dark boxes en route.

This information should aid classroom teachers and science teachers in the use of the moth for teaching. The scientist can store his cocoons below 65° to use at his convenience. Students experimenting on moths can see the results without waiting for the normal termination. More broods can be grown in a year, and so on.

[3] A time switch was used for accuracy.

MINUTES OF THE TWELFTH ANNUAL MEETING OF THE LEPIDOPTERISTS' SOCIETY AND NINTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION

August 25 and 26, 1962, Santa Barbara, California

Saturday, August 25

The joint meeting was called to order at 9:00 A.M. by Dr. John A. Comstock. Peter F. Bellinger was elected Secretary *pro tem.* Members of the society were welcomed by Dr. V. L. Vanderhoff, Director of the Santa Barbara Museum; in reply the chairman expressed the thanks of the society.

Dr. Comstock then delivered his Presidential Message, calling attention to the importance of accurate illustrations in entomological publications (see *Journal*, vol. 16, pp. 247–248). Dr. Vanderhoff took the opportunity to call members' attention to the dioramas in the museum and to Nelson Baker's illustrations for the insect hall.

Two invitational papers for the morning were given by Dr. Jerry A. Powell, who spoke on "Some observations on the minimum temperature threshold of moth activity at light," and by Frank Sala, who discussed the "astrologa complex" of the genus *Annaphila* (a paper since published: 1964, *Jour. Res. Lepid.*, 2: 289–301 "1963").

Following a group photograph and an excellent luncheon provided by the museum, the business meeting was called to order at 1:30 with Dr. C. L. Remington presiding. Motions of thanks to the staff and associates of the museum for their hospitality, and to Fred Thorne and Nelson Baker for their efforts on the program committee, were passed. Dr. Remington discussed publication plans for the *Journal* and *Memoirs,* and Dr. Tilden called for more material for the *News*, especially for the Season Summary; the possibility of using a standard form for submitting material for the summary was discussed. A motion by Fred Thorne was passed recommending the establishment of a class of patron members, with dues in excess of those charged sustaining members.

It was announced that the next meeting of the Society would be held in San Antonio, Texas, in the summer of 1963. A motion to hold the next meeting of the Pacific Slope Section at the Santa Barbara Museum in the last week of August in 1963 was passed, and Dr. Tilden was asked to head a committee to select a program committee.

The following papers were presented in the afternoon session:

Dr. J. W. Tilden—"Variations in *Speyeria* in the Sand Creek area of Oregon."

Oakley Shields—"Preliminary report on the Libytheidae."

Dr. William Hovanitz—"Preliminary analysis of populations of *Pieris protodice* and *Pieris occidentalis.*"

Lloyd M. Martin—"The genus *Lacinipolia.*"

The annual banquet was held at the Miramar Hotel. Following the banquet Dr. Comstock spoke on his experiences on a recent trip to Samoa and showed slides of the island and of some of the Lepidoptera which he was able to rear there.

Sunday, August 26

The final session was called to order at 9:30 with Dr. Tilden presiding. It was announced that Dr. Hovanitz would be program chairman and Nelson Baker local arrangements chairman for the next meeting of the Pacific Slope Section.

The following papers were presented:

Dr. C. L. Remington—"Hybridization studies of *Papilio*, *Limenitis* and *Callosamia.*"

Dr. Roger W. Pease, Jr.—"Geographic variation and polymorphism in the American *Utetheisa.*"

Wilbur S. McAlpine—"Butterflies of the genus *Calephelis.*"

Following the formal meetings, concluded at noon, members of the group were invited to an informal luncheon and open house at the home of Mr. and Mrs. Carl W. Kirkwood of Summerland. The hospitality of the Kirkwoods was greatly appreciated by those able to attend.—PETER F. BELLINGER, *Secretary pro tem*

MINUTES OF THE TENTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

August 24 and 25, 1963, Santa Barbara, California

Saturday, August 24

Following registration of members and a get-acquainted period, Mr. Lloyd M. Martin, Los Angeles County Museum, presided over the opening session. Miss Norma Morrer, Acting Director of the Santa Barbara Museum of Natural History, delivered an address of welcome.

Mr. Martin gave a report on the 1963 National Meeting of the Society, held during early August in San Antonio, Texas (see the *Journal*, vol. 18: 117–118, 1964).

Dr. Rudolph Mattoni, Downey, California, presented a paper "Homing behavior in *Philotes*"; a capture–mark–release–recapture study of a colony of *P. sonorensis* in the foothills of the San Gabriel Mountains in which two areas some 20 meters apart were designated and observed for cross movements.

Charles H. Abbott, Redondo Beach, reported on "The 1963 migration of *Vanessa cardui* and other recent observations"; included was a request for additional information of activities of other *Vanessa* species north of central California.

Following an excellent luncheon, again provided through the generosity of the staff of the Santa Barbara Museum of Natural History, a business meeting was held. The selection of a site for the 1964 meetings was made in response to an invitation from Mr. Peter Herlan of the Nevada State Museum at Carson City, and Dr. J. W. Tilden, San Jose State College, was elected program chairman with Mr. Herlan acting as local arrangements chairman. Considerable discussion followed the reading of a letter from Mr. Charles F. Harbison, San Diego Museum of Natural History, dealing with the problem of the selection of site and month having been made in past years by members present at the preceding meeting; that is, those who are able to attend at a given place and time of year are apt to select the same site, which tends to lessen, rather than increase, the geographical movement of the meeting site and breadth of the attending group. A system was proposed, including a committee to investigate possible meeting sites two years in advance and to report a recommendation at each meeting at the time the next site is to be selected. Mr. Harbison and Dr. E. O. Sette were appointed to look into the 1965 meeting site.

The afternoon session, with Dr. Mattoni presiding, included the following:

"*Philotes* of central coastal California," by Robert L. Langston, University of California, Berkeley: a paper subsequently published in this *Journal* (vol. 17: 201–223, 1964).

"Chemistry in Lepidopterology," by John M. Snider: use of chlorocresol as a mold preventer in holding fresh material; quaternary ammonium halide as an injection instant relaxer, and other little-known techniques were discussed.

"Genitalic and wing differences in western *Pieris*," by Vincent Chang, Los Angeles State College: a paper subsequently published (*Jour. Res. Lepid.*, 2(1): 97–125, 1963).

An exhibits and exchange period followed the afternoon session and included two well-prepared technique displays: a short explanatory introduction and display of equipment for field photography by Thomas C. Emmel, Stanford University; and Phillip A. Adams, University of California, Santa Barbara, showed a rubber stamp method for producing specimen labels; this inexpensive technique has since been published (*Jour. Res. Lepid.*, 2(3): 225–228, 1963).

The annual banquet was held at the El Mirasol Hotel and was followed by an illustrated lecture by Dr. William Hovanitz, the 1963 program chairman, on butterflies and their habits in the Canadian Arctic.

Sunday, August 25

Mr. Nelson Baker, Santa Barbara Museum of Natural History, presided over the morning session, which included the following papers:

"Patterns and variation of subspecies in *Philotes*," by Rudolf Mattoni: primarily a consideration of spot variation in *P. sonorensis.*

"Research in the genus *Lacinipolia*," by Lloyd M. Martin, Los Angeles County Museum: a progress report on taxonomic studies on Nearctic members of this large and difficult group.

"The origin of sympatric species in *Colias* through the aid of natural hybridization," by Dr. William Hovanitz, Arcadia, California: a paper currently being published (*Jour. Res. Lepid.*, 1(4): 261–274, 1963; 2(3): 205–223, 1963; 3(1): 37–44, 1964).

No formal session was planned for the afternoon of August 25. Members and guests were again treated to the hospitality of Mr. and Mrs. Carl Kirkwood, who provided refreshments at their home in nearby Summerland.—EDITOR

MINUTES OF THE ELEVENTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

July 18–20, 1964, Nevada State Museum, Carson City, Nevada

Saturday, July 18

The morning session was opened at 10:00 after the members and guests had registered. E. J. Newcomer presided over this session. Paul A. Opler was elected Secretary *pro tem.* Judge Clark J. Guild, founder of the Nevada State Museum and Chairman of the Board, welcomed the members and gave a brief history of the museum. After having accepted Judge Guild's welcome on behalf of the members, Dr. Newcomer read the message from the president of the society, Dr. J. G. Franclemont. Dr. Franclemont pointed out the unfilled gap in the knowledge of the immature stages of North American Heterocera.

The morning session was adjourned at 11:15 A.M. Mr. Peter Herlan conducted the members on a tour of the museum, after which the members were hosted at a luncheon by the Nevada State Museum.

Mr. Robert L. Langston presided at the afternoon session. A symposium, entitled "Collecting in Unusual Places," was given and consisted of the reading and discussion of the following papers:

1. "Collecting in Utah"—Kenneth B. Tidwell.
2. "Collecting in southern Texas"—J. W. Tilden, Biology Dept., San Jose State College, San Jose, California.
3. "Collecting in western Nevada"—Peter J. Herlan, Nevada State Museum, Carson City, Nevada.

A paper entitled "The distribution of *Lacinipolia olivacea* and its numerous subspecies" was presented by Lloyd M. Martin, Los Angeles County Museum, Los Angeles, California.

The meeting adjourned at 4:30 P.M.

Sunday, July 19

Dr. O. E. Sette presided at the morning session. Society business was conducted and the following topics were considered:

1. Since the treasurer of the Pacific Slope Section was not in attendance, the treasurer's report was deferred to 1965.

2. Dr. J. W. Tilden moved that the balance in the treasury remain as is and not be redistributed. The motion was seconded, discussed, and unanimously passed.

3. The society membership list was discussed and several suggestions were made to the secretary of the society, Dr. John C. Downey.

4. The society newsletter was discussed and several suggestions were made to the new editor, E. J. Newcomer.

5. It was decided that the 1965 meeting of the Pacific Slope Section be held at the San Diego Natural History Museum on the fourth weekend in June.

6. Charles Harbison and Fred Thorne were selected as cochairmen of the local arrangements and program committee.

7. Dr. Tilden moved that letters be sent to the Board of Trustees of the Nevada State Museum and to Mr. and Mrs. Peter J. Herlan thanking them for their hospitality during the meeting.

8. Dr. Downey proposed two resolutions which were discussed and approved by the members.

   a. Be it resolved that the Pacific Slope Section of the Lepidopterists' feels that the biennial membership list is of extreme value to the Society.

   b. Be it resolved that the membership expresses its appreciation to Dr. C. L. Remington, past editor of the *Journal*, and Dr. J. W. Tilden, past editor of the *News*, for the splendid job they have done and for their contributions to the Society. Be it also resolved that the Pacific Slope Section is pleased that Drs. Jerry A. Powell and E. J. Newcomer have accepted their editorial positions.

The business meeting was closed and the following two papers were read and discussed:

1. "The distributional aspects of the Rhopalocera of Yuba Pass, Sierra County, California"—Paul A. Opler, San Jose, California.

2. "Sound production in Lepidoptera"—Dr. John C. Downey, Southern Illinois University.

The morning session was adjourned at 12:30.

Dr. John C. Downey presided at the afternoon sessions. The following papers were read and discussed:

1. "Distribution of *Philotes* in North America"—Robert L. Langston, University of California, Berkeley, California.

2. "Sympatric colonies of *Euphydryas* in the Pacific Northwest"—David L. Bauer, Bijou, California.

3. "*Pieris yreka* Reakirt: a request"—F. Martin Brown.

"A study of the types of the W. H. Edwards names for butterflies"—F. Martin Brown, Fountain Valley School, Colorado. (Both papers were read by Dr. J. W. Tilden.)

Lloyd M. Martin showed colored slides of several specimens from the collection of the late Harold M. Bower, which was recently bequeathed to the Los Angeles County Museum. The collecton contained 41,000 specimens.

John and Tom Emmel showed colored slides of larvae and pupae of *Papilio indra minori*, *P. i. fordi*, and *P. i. pergamus*.

Paul A. Opler made a research request for information about the ecology or life history of any members of the genus *Euchloe*.

Dr. Downey adjourned the meetng at 4:45 P.M.

Monday, July 20

The members were led on a collecting trip of the Virginia City area by Mr. Herlan. Numerous specimens were taken including topotypes of *Tharsalea arota virginiensis* and *Icaricea icarioides ardea*.—PAUL A. OPLER, *Secretary pro tem*

MINUTES OF THE TWELFTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

June 19–21, 1965, San Diego, California

Saturday, June 19

Members and guests gathered at the museum for registration and informal discussion. Shortly after 10:00 A.M. the meeting was called to order by Dr. J. A. Comstock. R. L. Langston was elected Secretary–Treasurer *pro tem.* An address of welcome was given by Mrs. Jerri Heller, Acting Director, San Diego Natural History Museum. The acceptance by Dr. Comstock included historical aspects of the museum.

The President's Message by Dr. F. H. Rindge, American Museum of Natural History, New York, was read in his absence by Dr. Comstock (published in the *Journal*, vol. 19: 192–194, 1965).

The morning session included the following papers:

"Overwintering of *Agraulis vanillae* in the San Francisco Bay Region"—Dr. O. E. Sette, Los Altos, California. ("Valley climate" in study area, Los Altos; drastically reduced in cold winter months, the population increases by late summer and fall.)

"Problems in the classification of Nearctic *Euchloe*"—P. A. Opler, University of California, Berkeley. (Adult, larval, foodplant data, and statistics were given to suggest need for change in the species concepts with new name combinations in this genus of Pieridae.)

"The four lives of a butterfly"—S. N. Laverents. (An excellent sound film through the eyes of a commercial photographer, principally the life history of *Papilio zelicaon*, developed for use in public schools.)

The meeting was adjourned for the taking of group pictures and lunch.

The afternoon session was called to order with Dr. Sette presiding. The "Symposium on the giant skippers (Megathymidae)" which brought to San Diego many of the specialists from such distant places as Arizona, Kansas, and Texas, included the following papers:

"The eremology or desert habitat and distribution of western Megathymidae"—E. R. Tinkham, Yuma, Arizona. (Eremology was defined as the science of the desert. Accompanied by slides and several maps of the deserts throughout northern Mexico and western U. S.)

"The tools and problems of taxonomy in the Megathymidae"—D. B. Stallings, Caldwell, Kansas. (External morphology and genitalia are not enough as tools. Others include food preferences, study of immature stages, statistical methods, genetics and pH factor of soil.)

"Cremaster of the Megathymidae as a tool of taxonomy"—Mrs. Viola Stallings, Caldwell, Kansas. (Morphology of the pupal stage, particularly the cremaster diagnostic. Illustrated by colored slides.)

"Life histories of some Megathymidae"—Dr. J. A. Comstock, Del Mar, California. (Early stages, seasons, and comparisons of yucca feeders and agave feeders, prime examples being *M. yuccae martini* and *A. stephensi.*)

"Speciation in the Agathymus"—H. A. Freeman, Garland, Texas. (Theories on development of species in this most complex genus, particularly in northern Mexico.)

"Early observations of *Agathymus stephensi*"—Mrs. Kate Stephens (1851–1954). (Mimeographed copies were provided by the *Los Entomologos.* Narrative on experiences with this giant skipper in the La Puerta area of the Vallecitos Desert in the 1880's.)

"Chromosomes of the Megathymidae and their relation to classification and speciation"—Dr. C. L. Remington, Yale University, New Haven, Connecticut. (Read in his absence by D. B. Stallings. Stated that *Agathymus* with basic $5n$ or multiples—5, 10, 15, 20, etc.; yucca feedings in the U. S. with 26, 27, or 29 chromosomes.)

"Bionomics and morphology of *Megathymus* at the species complex level"—Kilian

Roever, Phoenix, Arizona. (There are four major complexes: *yuccae, ursus, cofaqui,* and *streckeri*; confirmed by studies on early stages.)

"Problems in the botany of host plants of the Megathymidae"—C. F. Harbison, San Diego. (Time did not permit presentation of this paper, but a display of numerous potted *Agave* was available during the meetings, and a planting of many species of agaves and yuccas were growing near the museum.)

After a brief coffee break, the symposium continued with most of the above speakers forming a panel; panel members made statements and directed questions. Then the symposium was thrown open to audience questions and discussions. Participation was vigorous, despite lateness of the hour.

The annual banquet was held at a restaurant a few blocks west of Balboa Park. Following dinner, Dr. J. A. Comstock and Dr. F. X. Williams reminisced on the old-time entomologists, most of whom either one or the other or both have known personally; the talk was accompanied by lantern slides of photographs of many early personalities.

Sunday, June 20

At 9:20 A.M. the meeting was called to order, with Dr. J. W. Tilden presiding. The program included the following presentations:

"Biological interrelationships of prodoxid moths and *Yucca whipplei*"—Dr. J. A. Powell, University of California, Berkeley. (With each feeding at different loci—seeds, pods, high or low on stalk; four species are associated with *Y. whipplei*: *Tegeticula maculata*, *Prodoxus marginatus*, *P. cinereus*, and *P. aenescens.* None of these moths has ever been taken on any other species of yucca.)

"Population biology of a *Plebejus icarioides* colony"—T. C. Emmel, Stanford University. (A colony on the Stanford Campus was mapped, butterflies marked and studied over a several-acre area. Recaptures were made up to 1,000 feet away from original colony sites.)

"Comparative morphology of the mesothoracic aorta in the Rhopalocera"—J. H. Hessel, Tucson, Arizona. (Differences among species and to a greater degree between families. Many more need dissecting to draw conclusions.)

"A Venezuelan collecting trip"—John Masters, Osceola, Arkansas. (Illustrated with color slides, particularly of forested areas and jungle clearings where many desirable species were taken.)

After a short break, the business meeting was called to order in the coffee room.

Resolutions: It was moved and passed unanimously that the group officially thank the hosts for a very successful meeting; moved and passed that the secretary express thanks by letter to the San Diego Natural History Museum and to the program chairman, F. T. Thorne. It was moved and passed that C. F. Harbison be reimbursed for the refreshments from the registration fees.

Treasurer's report: R. L. Langston reported $31.00 collected in registration fees. Nelson Baker, as permanent treasurer, reported that the Pacific Slope Section had $96.00 on deposit. It was moved and passed that since there were no outstanding debts at this time, it should be kept in the bank for future emergencies.

Selection of 1966 meeting place and date: Nelson Baker offered on behalf of the Santa Barbara Museum, and the 1966 meeting was approved for Santa Barbara. A show of hands approved the third week in June. Since the meetings have never been in the Pacific Northwest, E. J. Newcomer made a 1967 tentative invitation for some place in Oregon, such as Corvallis. An informal show of hands indicated a favorable reaction to such a site.

Election of 1966 program committee: It was moved and passed that Nelson Baker be local arrangements chairman. Dr. C. L. Hogue was elected program chairman. His assistants were chosen as Ron Leuschner and Tom Emmel.

Other business matters: Dr. J. A. Powell, editor of the *Journal*, mentioned that although there is no charge to authors for illustrations (line and halftone) with the new printer, contributions to the illustrations fund are still encouraged in order to

support colorplates. E. J. Newcomer, editor of the *News,* asked for comments and suggestions in relation to the season's summary. (A questionnaire has since appeared in the *News.*) Fred Thorne, as program chairman, gave his thanks to *Los Entomologos* and the Museum Directors for providing a memorable meeting place.

During the remaining time P. A. Opler showed slides of some unusual gynandromorphs, aberrant forms, and examples of certain Lycaenidae and Riodinidae. Dr. J. W. Tilden also showed slides taken during his recent stay in Hawaii. The meeting then adjourned for lunch.

On Sunday afternoon no organized activities were scheduled.

Monday, June 21

Many of the members and their guests met for a bus trip to the Laguna Mountains in eastern San Diego County. East of El Cajon, the bus drove out of the overcast that plagued the meeting in San Diego. With warm, sunny conditions, collecting was good at all six localities visited in the Mt. Laguna–Cuyamaca area. Some species were in their peak flight, many common, and a few choice "rarities" were taken. Although most were what the resident collector would expect, it is certain that it would be considered a very successful day by the out-of-state collectors.

According to the registration list, 10 states were represented: Arizona, Arkansas, California, Colorado, Kansas, Nevada, Ohio, Oregon, Texas, and Washington. Members, guests, and speakers who attended included:

E. N. Agey, R. Albright, G. T. and Mrs. Austin, N. W. and Mrs. Baker, Andre and Mrs. Blanchard, R. W. Breedlove, J. A. Comstock, S. L. Ellis, T. C. Emmel, R. Fall, H. A. and Mrs. Freeman, R. S. Funk, C. F. Harbison, W. A. and Mrs. Hedges, Mrs. J. Heller, P. J. and Mrs. Herlan, J. H. and Mrs. Hessel, C. L. and Mrs. Hogue, W. Hovanitz, J. Lane, R. L. and Mrs. Langston, S. N. Laverents, R. H. and Mrs. Leuschner, A. C. Lyngholm, L. M. and Mrs. Martin, J. H. Masters, R. P. Minahan, E. J. Newcomer, P. A. and Mrs. Opler, J. A. Powell, W. S. Radcliffe, J. Roberds, K. Roever, Allen and Mrs. Rubbert, O. E. Sette, D. B. and Mrs. Stallings, R. E. and Mrs. Stanford, R. H. Stewart, D. Studebaker, F. T. and Mrs. Thorne, J. W. Tilden, E. R. Tinkham, Mrs. M. A. Turner and F. X. Williams.—ROBERT L. LANGSTON, *Secretary pro tem*

ANNOUNCEMENT OF ANNUAL MEETING

The Seventeenth Annual Meeting of the Lepidopterists' Society will be held in OTTAWA, ONTARIO, from the evening of SUNDAY, MAY 29 to the morning of WEDNESDAY, JUNE 1, 1966.

The general theme of the program will be: LEPIDOPTERA AROUND THE WORLD.

We hope the program will be of interest to amateurs and professionals alike. Field trips will form a part of the program.

The period of the meetings coincides with the Ottawa Tulip Festival and with Memorial Day in the United States; it should be an excellent time to collect some interesting local butterflies and moths, including some subarctic intrusions.

Those wishing to participate in the program or requiring further information should contact:

Dr. D. F. Hardwick,
Entomology Research Institute,
K. W. Neatby Building,
Ottawa, Ontario, Canada.

Papers to be delivered at the meetings should be received in Ottawa not later than March 1, 1966.

Further announcements concerning the program will appear in the *News* at a later date.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Required six-months' public notice is given on the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names, listed by Case Number (see *Bull. zool. Nomencl.* 22, pt. 4, 2 November 1965):

1706. Type-species for *Phasia* Latreille, 1804 (Insecta, Diptera).

1708. Suppression of *Papilio lintingensis* Osbeck, 1765 (Insecta, Lepidoptera).

1709. Type-species for *Monopsyllus* Kolenati, 1875; Suppression of *Ceratopsyllus sciuri* Kolenati, 1856, *Monopsyllus sciuri* Kolenati, 1857, and *Ceratopsyllus monoctenus* Kolenati, 1856 (Insecta, Siphonaptera).

1710. Type-species for *Stizus* Latreille, [1802–1803] (Insecta, Hymenoptera).

1711. Type-species for *Diodontus* Curtis, 1834 (Insecta, Hymenoptera).

1712. Type-species for *Trychosis* Foerster, 1868 (Insecta, Hymenoptera).

1713. Type-species for *Prospaltella* Ashmead, 1904 (Insecta, Hymenoptera).

1716. Type-species for *Chamaemyia* Meigen, 1803 (Insecta, Diptera).

1720. Suppression of *Xyleborus* Bowdich, 1825 (Insecta, Coleoptera).

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London S.W. 7, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature.*

BOOK NOTICE

MOUCHA, J., & F. PROCHÁZKA: Beautiful Butterflies. 135 pp., 56 pls. London: Spring Books. 1963.

This book is an attractive introduction to the diurnal Lepidoptera for the layman. An interesting and informative discussion of the group is followed by a series of magnificant plates, representing some spectacular tropical species and some representative European forms, with remarks on their distribution, biology, and variation. All families except the Hesperiidae are represented.—PETER F. BELLINGER

RECENT LITERATURE ON LEPIDOPTERA

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here. Papers of only local interest and papers from this *Journal* are listed without abstract. Readers, not in North America, interested in assisting with the abstracting, are invited to write Dr. P. F. Bellinger (Department of Biological Sciences, San Fernando Valley State College, Northridge, California, U.S.A.). Abstractor's initials are as follows:

[P.B.] — P. F. Bellinger [W.H.] — W. Hackman [N.O.] — N. S. Obraztsov
[I.C.] — I. F. B. Common [T.I.] — Taro Iwase [C.R.] — C. L. Remington
[W.C.] — W. C. Cook [T.L.] — T. W. Langer [J.T.] — J. W. Tilden
[A.D.] — A. Diakonoff [J.M.] — J. Moucha [P.V.] — P. E. L. Viette
[J.D.] — Julian Donahue [E.M.] — E. G. Munroe

B. SYSTEMATICS AND NOMENCLATURE

Reisser, Hans, "Beiträge zur Kenntnis der Sterrhinae (Lep., Geom.) VI. *Sterrha alicantaria* sp. n., eine neue Art der südspanischen Küstengebiete" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 45–51, 1 pl., 4 figs. 1963. Type locality Alicante, S. Spain.

Řezáč, Miroslav, "Zur Bionomie der *Argyresthia*-Arten auf mitteleuropäischen Obstbaumarten" [in German; Czech summary]. *Zool. Listy (Folia zool.)*, 12: 43–62, 12 figs., 2 col. pls. 1963. Life-history and taxonomic discussion of four spp. (*pruniella, cornella, albistria* and *mendica*). [J. M.]

Riedl, Tadeusz, "Matériaux pour la connaissance des Momphidae (Lepidoptera) paléarctiques. Partie II. Sur quelques espèces des genres *Mompha* Hbn. et *Psacaphora* H.S. de la faune polonaise" [in French; Polish summary]. *Bull. ent. Pologne*, 33: 101–106, 5 figs. 1963. 3 spp. from Poland are recorded; descriptions & figures of genitalia. [J. M.]

Reidl, Tadeusz, "Beitrag zur Kenntnis der paläarktischen Momphidae. I. *Sorhagenia rhamniella* (Zell.) und zwei neue europäische Arten der Gattung *Sorhagenia* Spul." [in German; Polish summary]. *Bull. ent. Pologne*, 32: 69–75, 8 figs. 1962. New species: *S. janiszewskae* (Wroclaw, Poland) & *S. tolli* (Poland). Genitalia & imagines figured. [J. M.]

Rindge, Frederick H., "A new species of *Melanchroia* (Lepidoptera, Geometridae) from Jamaica." *Jour. N. Y. Ent. Soc.*, 69: 142–144, 2 figs. 1961. Describes as new *M. venata* (Milk River Bath). [P. B.]

Rindge, Frederick H., "A revision of the Nacophorini (Lepidoptera, Geometridae)." *Bull. Amer. Mus. Nat. Hist.*, 123: 87–154, 6 pls., 46 figs. 1961. Retains this tribal name, although *Nacophora* is sunk to *Phaeoura*. Describes as new *Betulodes euriceraea* (Zamora, Ecuador, 3,000–4,000 ft.); *Phaeoura kirkwoodi* (Pinery Canyon, Chiricahua Mts., Ariz.), *P. ianthina* (La Polvosa, Chihuahua, Mex.), *P. spadix* (?Acapulco, Mex.), *P. belua* (Southwestern Research Station, Cochise Co., Ariz., 5,400 ft.), *P. aetha* (Smoky Valley, Tulare Co., Calif.), *P. cana* (Camp Angelus, San Bernardino Co., Calif.); *Thyrinteina arnobia phala* (Chichen Itza, Yucatan), *T. unicornis* (Phoenix Park, Moneague, St. Ann Parish, Jamaica), *T. leucoceraea* (Hansa Humboldt, Santa Catherina, Brazil); *Holochroa dissociaria varia* (Gran Quivira National Monument, Socorro Co., New Mexico). Revision includes 22 spp. in these four genera; all are redescribed, and keys based on external characters & on genitalia of each sex are given. [P. B.]

Rindge, Frederick H., "A synopsis of the genus *Nycteola* from North America, including a new species from Arizona (Lepidoptera: Noctuidae)." *Jour. N. Y.*

Ent. Soc., 69: 203–206, 2 figs. 1961. Describes as new *N. fletcheri* (Southwestern Research Station, Cochise Co., Ariz., 5,400 ft.). Gives keys to the five North American spp., based on genitalia. [P. B.]

Rindge, Frederick H., "Descriptions of and notes on North American Geometridae (Lepidoptera), no. 5." *Amer. Mus. Novit.*, no. 2065: 11 pp. 1961. Describes as new *Yermoia glaucina* (Morongo Wash, San Bernardino Co., Calif.), and reviews genus (including also *perplexata*). Redescribes *Itame abruptata*, n. comb. Transfers *Bombycia candida* from Thyatiridae to *Stenocharis*. Records *Olneya tesota* as foodplant of *Glaucina eupitheciaria lucida*. [P. B.]

Rindge, Frederick H., "Notes on and descriptions of North American *Eupithecia* (Lepidoptera, Geometridae)." *Amer. Mus. Novit.*, no. 2147: 23 pp., 7 figs. 1963. Describes as new *E. phyllisae* (Horseshoe Springs Camp., 2 m. W. of La Cueva, Sandoval Co., New Mexico, 7,900 ft.), *E. hohokamae* (5 mi. W. of Portal, Cochise Co., Ariz.). Notes on 46 other spp., including additional distribution records, some new synonymy, & description of previously unknown sexes of *E. sperryi* & *E. sinuata*. [P. B.]

Rindge, Frederick H., "A revision of the genera *Anavinemina* and *Vinemina* (Lepidoptera, Geometridae)." *Amer. Mus. Novit.*, no. 2172: 40 pp., 26 figs. 1964. Describes as new *ANAVINEMINA* (type *Tephrosia muraena*), *A. promuraena* (Popocatepetl Park, Mexico), *A. molybra* (Cerro Pelon, Municipio Yolox, Oaxaca, Mexico), *A. axicata* (Mexico City), *A. orphna* (Popocatepetl Park); *V. muraenata* (Totonicapán, Guatemala). 12 spp. are included in these two genera. [P. B.]

Rindge, Frederick H., "A revision of the genera *Carphoides, Paraphoides*, and *Galenara* (Lepidoptera, Geometridae)." *Amer. Mus. Novit.*, no. 2189: 53 pp., 33 figs. 1964. Describes as new *PARAPHOIDES* (type *Tephrosia bura* Druce), *P. foeda* (Juan Vinas, Costa Rica, 1,400 m.), *P. vafra* (Jalapa, Mexico), *P. largifica* (Santa Rosa de Comitan, Chiapas, Mexico), *P. stulta* (Mo Cuou, Cerro Pelon, Municipio Yolox, Oaxaca, Mexico, 7,050 ft.). Redescribes the two other spp. of *Paraphoides*, three spp. of *Carphoides*, & nine spp. of *Galenara*. Third in a series of papers on genera near *Melanolophia*; spp. are found from the southwestern United States to Costa Rica. [P. B.]

Rindge, Frederick H., "A revision of the genera *Melanolophia, Pherotesia*, and *MELANOTESIA* (Lepidoptera, Geometridae)." *Bull. Amer. Mus. Nat. Hist.*, 126: 241–434, 7 pls., 163 figs. 1964. Describes as new *Melanolophia modica* (Santa Cruz, S. Brazil), *M. vitta* (Petropolis, Brazil), *M. substriata* (Rio Negro, Colombia, 800 m.), *M. inatrata* (Region Chapare, Bolivia, 400 m.), *M. umbrosa* (Region Chapare), *M. piura* (Huancabamba, Peru), *M. producta* (Balzapamba, Bolivar, Ecuador), *M. vulsa* (Sierra del Libane, Colombia, 6,000 ft.), *M. rubrica* (Cayuga, Guatemala), *M. eudoxa* (Chapare, Bolivia), *M. e. simpla* (Cañon del Tolima, Colombia, 1,700 m.), *M. trisurca elongata* (Incachaca, Cochabamba), *M. vegranda* (Balzapamba, Bolivar, Ecuador), *M. perversa* (Nueva Teutonia, Brazil), *M. triloba* (Jalapa, Mexico), *M. penicilla* (Zamora, Ecuador), *M. atrifascia* (Barro Colorado Is., Canal Zone), *M. homofascia* (San Esteban, Venezuela), *M. sadrina conara* (Muzo, Colombia), *M. sadrinaria* (San José, Costa Rica, 5,000 ft.), *M. imitata cana* (upper Santa Ana R., San Bernardino Co., Calif.), *M. flexilinea fragosa* (Puntarenas, Monte Verde, Costa Rica), *M. canadaria crama* (Lyons Farms, Union Co., New Jersey), *M. canadaria choctawae* (Clinton, Hinds Co., Mississippi), *M. signataria timucuae* (Pensacola, Florida), *M. imperfectaria solida* (Guadalajara, Mexico), *M. fimbriata* (El Volcan, Chiriqui, Panama), *M. parma* (Tuis, Costa Rica, 2,400 ft.), *M. pseudovallata* (Chapare, Bolivia), *M. reducta meridiana* (Oconeque, Carabaya, Peru, 7,000 ft.), *M. r. borea* (Cañon del Tolima, Colombia, 2,700 m.), *M. reductaria* (Agualani, Carabaya, Peru, 9,000 m.), *M. dextera* (Sierra del Libane, Colombia, 6,000 ft.), *M. isoforma* (Monte Tolima, Colombia, 2,700 m.), *M. isometra* (near Loja, Ecuador), *M. attenuata* (Mt. Poas, Costa Rica), *M. synargilaria* (Chachapoyas, Amazonas, Peru), *M. venatia* (Rio Songo, Bolivia),

M. elegia (Vista Hermosa, Oaxaca, Mexico, 4,650 ft.), *M. mallea* (Chanchamayo, Peru), *M. bugnathos* (Yungas del Palmar, Bolivia), *M. b. contracta* (Balzapamba, Bolivar, Ecuador), *M. b. elaphra* (El Volcan, Chiriqui, Panama), *M. conta* (Chanchamayo, Peru), *M. minca* (Minca, Colombia, 2,000 ft.), *M. rima* (Muzo, Colombia), *M. semarcata* (La Merced, Peru), *M. paraconara* (Popayan, Colombia), *M. orthoconara* (Lino, Panama, 800 m.); *Pherotesia simulatrix* (Yuntas, near Cali, Colombia), *P. lima* ("Intaj," Ecuador), *P. ultrasimilis* (Coosnipata, Paucartambo, Cuzco, Peru), *P. lunata* (Sierra del Libane, Colombia, 6,000 ft.), *P. malinaria minuisca* (Volcan de Chiriqui, Panama), *P. falcis* (Popocatepetl Park, Mexico), *P. hamata* (Mo Cuou, Cerro Pelon, Oaxaca, Mexico, 7,050 ft.), *P. caeca* (Orizaba, Veracruz, Mexico), *P. bifurca* (Volcan Santa Maria, Guatemala); *MELANOTESIA* (type *Calospila? siderata* Dognin). The revision of this predominantly neotropical group of Ennominae includes 112 spp. & sspp. [P. B.]

Roever, Kilian, "Notes on *Erora* (Lycaenidae)." *Jour. Lepid. Soc.*, 16: 1–4. 1962.

Ross, D. A., "The Maple Leaf Cutter, *Paraclemensia acerifoliella* (Fitch) (Lepidoptera: Incurvariidae), descriptions of stages." *Canad. Ent.*, 90: 541–555, 38 figs. 1958. Describes morphology of early stages & adults. [P. B]

Rougeot, P. C., "*Limenitis populi* L. varie-t-il localement en France? (Nymphalidae)" [in French]. *Alexanor*, 2: 8–10. 1961. Description of *L. p. forezianus* (central France, Loire, Mt. Forez). [P. V.]

Rougeot, P. C., "Lépidoptères attacides du Musee de Dundo (Angola)" [in French]. *Publ. cult. Comp. Diam. Angola*, no. 58: 143–154. 1962. List of 24 spp. or sspp. belonging to the Dundo Museum in Angola. One of these cited species is *Pseudantheraea imperator* Rougeot (p. 149). About the name of this species, the author writes: "Noteworthy male specimen (151 mm.) dedicated the 22nd of March, 1961 to the general de Gaulle, President of the French Republic." Two criticisms will be made: (1) it is a pity to see entomology and politics mixed; (2) it will be noted, about this dedication, two errors: (a) the indication of the dedication appears in a publication subsequent to that in which the species was described; (b) a name given in honor of President de Gaulle should be, according to the *Rules*, *gaullei*. [P. V.]

Sala, Frank P., "The *Annaphila astrologa* complex, with descriptions of three new species." *Jour. Res. Lepid.*, 2: 289–300, 4 pls. "1963" [1964]. Describes as new *A. olgae* ("Arizona"), *A. pseudoastrologa* (above Seminole Hot Springs, Santa Monica Mts., Calif.), *A. vivianae* (Lower Kern Canyon, Kern Co., Calif.). Redefines *A. astrologa*. [P. B.]

Sattler, Klaus, "Was ist *Gelechia trauniella* Zeller, 1868?" [in German]. *Zeitschr. wiener ent. Ges.*, 45: 92–93, 1 fig. 1960. Transfers sp. to *Caryocolum*, comparing it with *C. saginellum*; figures ♂ genitalia. [P. B.]

Sattler, Klaus, "Neue Synonyme europäischer Gelechiidae" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 30–31. 1961. Sinks *Lita nitentella* to *Scrobipalpa obsoletella*; *Gelechia decrepidella* to *Bryotropha desertella*; *G. nigrobipunctella* to *Lita solutella*. [P. B.]

Sattler, Klaus, "On the synonymy of *Anacampsis populella* (Clerck) and *A. blattariella* (Hübner) (Lep., Gelechiidae)." *Ent. Gazette*, 12: 115–116. 1961. Sinks *betulinella* to *blattariella*, & *ambronella* to *A. p. fuscatella*. Gives synonymy & references to figures. [P. B.]

Sattler, Klaus, "Über *Mirificarma cabezella* (Chrét., 1925)" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 86–88, 4 figs. 1961. Redescribes this sp. Lists foodplants of *Mirificarma* spp. [P. B.]

Sattler, Klaus, "Zwei neue Arten der Gattung *Filatima* Busck, 1939 (Lep., Gelech.)" [in German]. *Deutsche ent. Zeitschr.*, N.F., 8: 117–120, 2 figs. 1961. Describes as new *F. angustipennis* (L'Argentiere, French Alps), *F. asiatica* (Alexander Mts.). [P. B.]

Sattler, Klaus, "Der Wickler *Apotomis infida* (Heinrich, 1926) in Deutschland (Lepidoptera, Tortricidae)" [in German]. *Zeitschr. wiener ent. Ges.*, 47: 157–159, 6

figs. 1962. Describes sp. & figures genitalia; new to Germany. Foodplant *Salix*. [P. B.]

Sattler, Klaus, "Die Gattung *Xystophora* Heinemann, 1876 (Lep. Gelechiidae)" [in German]. *Deutsche ent. Zeitschr.*, N.F., 9: 325–331, 9 figs. 1962. Revision of genus, with key to the 3 spp.: *pulveratella* (= *steudeliella*, n. syn.), *carchariella*, & *psammitella*. [P. B.]

Sattler, Klaus, "Zur Kenntnis der Gattung *Plagodis* Hübner, 1823 (Lepidoptera: Geometridae)" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 25–32, 1 pl., 8 figs. 1963. Sinks *Anagoga* to *Plagodis*, following extended comparison of type spp., *P. dolabraria* & *A. pulveraria*; describes wild hybrid between these (figures in color of both spp. & hybrid). [P. B.]

Sattler, Klaus, "Über *Telphusa canariensis* Walshingham, 1908" [in German]. *Zeitschr. wiener ent. Ges.*, 49: 88–90, 4 figs. 1964. Describes genitalia & assigns this gelechiid to *Streyella*. [P. B.]

v. Schantz, Max, "*Eucosma danicana* n. sp. und einige dieser nahestehende *Eucosma*-Arten" [in German]. *Notul. Ent.*, 42: 1–8, 11 figs. 1962. Described from Maribo, Denmark; reared from *Picris*. Descriptive notes on *E. cana, E. fulvana, E. hohenwartiana, E. expallidana*, & *E. scorzonerana*. [P. B.]

Schnaider, Józef, Janina Schneider, & Zbigniew Schnaider, "Przezierniki—Aegeriidae" [in Polish]. *Klucze do Oznacz. Owadow polski*, 27, part 37 (no. 34), 42 pp., 6 pls., 53 figs. 1961. See review in *Journal*, 15: 132.

Schütze, Eduard, "Über einige nordafrikanische Eupithecien (Lep. Geom.) Eupithecien-Studien XIV" [in German]. *Deutsche ent. Zeitschr.*, N.F., 8: 147–151, 6 figs. 1961. Sinks *Eupithecia pseudoscriptoria* to *E. elissa*; describes genitalia & other features of *E. elissa, E. unitaria*, & *E. orana*. [P. B.]

Schütze, Eduard, "Weitere Eupithecien aus Iran und Arabien (Lep. Geom.) (Eupithecien-Studien XVII)" [in German]. *Mitt. münchner ent. Ges.*, 51: 58–71, 8 pls. 1961. Describes as new *E. inquinata* (Iranshar, Baluchistan); *E.* (*DELAEVERIA*) (type *E. gueneata*), *E.* (*D.*) *subscalptata* (Makran, SE of Nahu, 1,300 m., Persia), *E.* (*D.*) *albertiata*. Notes on 14 other spp. [P. B.]

Schwarz, Rudolf, "Bestimmungstabelle der Scopariinae Mitteleuropas" [in German]. *Zeitschr. Arbeitsgen. österr. Ent.*, 15: 37–50, 15 figs. 1963. Keys to 23 spp. of *Scoparia* based on external characters and (except for 10 spp. of subgenus *Eudoria*) on ♂ genitalia; the first key includes notes on distribution, variation, & biology. [P. B.]

Schwarz, R., & E. Nicolescu, "Morphologische, biologische und systematische Beiträge zur Kenntnis der Aegeriidae (Lepidoptera)" [in German]. *Zeitschr. Arbeitsgen. österr. Ent.*, 14: 42–47, 4 figs. 1962. Describes genitalia of *Aegeria apiformis, A. crabroniformis*, & *A. melanocephala*, & early stages of the first two. [P. B.]

Schwingenschuss, Leo, "Nachträge, Ergänzungen und Berichtigungen zur 'Lepidopterenfauna von Albarricin in Aragonien' von H. Zerny" [in German]. *Zeitschr. wiener ent. Ges.*, 47: 4–11. 1962. Describes as new *Agrotis* (*Rhyacia*) *elegans aragonensis, A.* (*R.*) *candelisequa zapateri, A.* (*R.*) *renigera hispanicola*; *Mamestra* (*Polia*) *genistae caerulescens*; *Polia* (*Antitype*) *dubia lutea*. Also names two "forms" of *Lithina convergata*. Notes o nidentity of 63 spp. (Noctuidae, Geometridae, Arctiidae, Zygaenidae) from Albarricin, Spain. The new entities are very superficially characterized; the publication of this paper from the author's manuscript, eight years after his death, is regrettable. [P. B.]

Sheljuzhko, Leo, "Zur Kenntnis der *Pieris melete*-Gruppe" [in German]. *Zeitschr. wiener ent. Ges.*, 45: 4–13, 20–29, 36–51, 5 pls., 2 figs. 1960. Survey of geographic & seasonal variation in *P. melete* & *P. dulcinea*, which are good, separate spp.; names in this group are discussed and original & later descriptions repeated. Names an "ab.," and a spring form of *P. m. orientis*. The involved synonymy is is given in full. [P. B.]

Sheljuzhko, Leo, "Zur Kenntnis der *Pieris melete*-Gruppe. Teil II. Nordliche Inseln: Sachalin (= Saghalien, Karafuto) und die Kurilen" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 6–10, 51–64, 141, 5 pls., 1 map. 1963. Exhaustive review of *P. napi saghalensis, P. n. kurilina*, & *P. melete tomariana*, & supplementary note to first part (on *P. n. dulcinea* & *P. n. sichotensis*). [P. B.]

Shepard, Jon H., "The genus *Lycaeides* in the Pacific northwest." *Jour. Res. Lepid.*, 3: 25–36, 1 pl., 1 map. 1964. Survey of *L. melissa* & the three races of *L. argyrognomon*; figures of representative specimens from localities in British Columbia & northwestern states. [P. B.]

Sieder, Leo, "Eine neue Psychide aus dem Chelmosgebiet in Griechenland (Lepidopt., Psychidae). HELLENIINAE subfam. nov. *HELLENIA* gen. nov. *culminella* spec. nov." [in German]. *Zeitschr. wiener ent. Ges.*, 46: 121–126, 1 pl., 2 figs. 1961. Type locality: summit of Mt. Chelmos, 2,355 m., Peloponnesus. [P. B.]

Sieder, Leo, "Eine neue Psychide aus dem Gebiet der Gurktaler Alpen in Kärnten (Lepidoptera Psychidae)" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 90–93, 129–130, 1 pl., 5 figs. 1963. Describes as new *Proutia breviserrata* (Fadenhöhe, 1,500 m., near Reichenau). [P. B.]

Sieder, Leo, "Eine neue Psychide aus Nordostspanien (Lepidoptera Psychidae). *Brevantennia pinkeri* spec. nov." [in German]. *Zeitschr. wiener ent. Ges.*, 49: 69–72, 1 pl. 1964. Type locality Port Bou, Spain. [P. B.]

Soffner, Josef, "Zwei neue Lepidopteren-Arten aus Bulgarien" [in German]. *Deutsche ent. Zeitschr.*, N.F., 9: 139–141, 5 figs. 1962. Describes as new *Euzophera nessebarella* (Nessebar, Black Sea Coast); *Semasia nessebarana* (Nessebar). [P. B.]

van Someren, V. G. L., "Systematic notes on the associated blue-banded black *Papilios* of the *bromius-brontes-sosia* complex of Kenya and Uganda, with descriptions of two new species" [in English; Portuguese summary]. *Bol. Soc. Estud. Prov. Moçambique*, no. 123: 63–78, 11 pls., 3 maps. 1960. Describes as new *P. brontes australis* (Tanganyika: Usambara Range), *P. teita* (Kenya: Wandanyi-Mabida, Teita Range); *P. interjecta* (Kenya: Kaimosi Forest). Discusses East African races of *P. brontes, P. bromius, P. sosia*, & *P. nireus*, with some descriptions & figures; holotype of *P. b. brontes* figured. [P. B.]

van Someren, V. G. L., "A new *Charaxes* (Lepidoptera: Nymphalidae). *Proc. R. ent. Soc. London (B)*, 31: 44–46, 2 pls. 1962. Describes as new *C. kulal* (Kenya, Mt. Kulal, SE of L. Rudolf). [P. B.]

Stallings, Don B., J. R. Turner, & Viola N. Stallings, "A new subspecies of *Agathymus mariae* from Mexico (Agathymidae)." *Jour. Lepid. Soc.*, 15: 19–22, 1 pl. 1961. Describes as new *A. m. micheneri* (15–20 mi. S. of Allende, Coahuila, 1,300 ft.).

Stallings, Don B., J. R. Turner, & Viola N. Stallings, "Two new species and one new subspecies of Megathymidae from Mexico and Texas." *Jour. Lepid. Soc.*, 17: 81–88, 19 figs. 1963. Describes as new *Megathymus gayleae* (23 km. N. of Saltillo, Coahuila, Mexico, 4,200 ft.); *Stallingsia jacki* (Tuxtla Gutierrez, Chiapas, Mexico, 2,500 ft.); *Megathymus yuccae reubeni* (Hueco Mts., Texas, 5,300 ft.).

Stallings, Don B., J. R. Turner, & Viola N. Stallings, "Notes on five Megathymidae." *Jour. Lepid. Soc.*, 18: 45–47. 1964.

Stempffer, H., "Contribution à l'étude des lépidoptères Lycaenidae de l'Afrique équatoriale" [in French]. *Ann. Mus. R. Afrique centr.*, Tervuren, ser. in 8°, no. 94, 73 pp., 4 pls. 1960. Study on the Lycaenidae of equatorial Africa, with the revision of the genera *Pseuderesia* and *Syrmoptera* and descriptions of new species and subspecies: *Telipna katangae* (Belgian Congo, Katanga); *Ornipholidotos jacksoni* (Uganda, Sango Bay); *Pseuderesia eleaza katera* (Sango Bay), *P. beni* (N. Kivu, Beni), *P. rougeoti* (Gaboon, Tchibanga), *P. clenchi* (Cameroon, Bitje, Ja R.); *MIMERESIA* (type species: *Liptena libertina* Hewitson), *M. drucei owerri* (Nigeria, Owerri area), *M. russulus unyoro* (Uganda, Unyoro); *Liptena nigromarginata* nom. nov. pro *jacksoni* Stempffer, 1953, *L. ogojae* (Nigeria, Ogoja area); *Eresina pseudofusca* (Ghana, Kpandu), *E. jacksoni* (Uganda, Toro); *Toxochitona sankuru* (Belgian Congo, Sankuru); *Myrina sharpei fontainei* (Bel-

gian Congo, Uele); *Syrmoptera bonifacei* (Cameroon, Mamfe); *Aphnaeus asterius ugandae* (Uganda, Masaka); *Pseudaletis nigra fontainei* (Belgian Congo, Sankuru), *P. lusambo* (Sankuru); *Anthene hobleyi kigezi* (Uganda, Kigezi), *A. h. teita* (SE Kenya, Voi), *A. musagetes jeanneli* nom. nov. pro *elgonensis* Stampffer; *Harpendyreus marlieri* (Kivu, Mt. Muhi), *H. argenteostriatus* (Mt. Muhi); *Eicochrysops fontainei* (Belgian Congo, Léopoldville). [P. V.]

Stempffer, H., "Compléments a la révision des genres du groupe des *Iolaus* (Lep. Lycaenidae)" [in French]. *Bull. Inst. franç, Afr. noire (A)*, 23: 88–101, 32 figs. 1961. A complementary note to the revision of the genera *Iolaus* group, with descriptions of many unknown females obtained by breeding; they are the neallotypes of: *Iolaphilus maritimus* Stempffer & Bennett (Kenya), *I. gabunica* Riley (Uganda), *Epamera tajoraca* (Somaliland), *E. bellina exquisita* Riley (Uganda), *E. gemmarius* H. H. Druce (Nigeria), *E. agnes* (Nigeria), *E. neavei katera* Talbot (Uganda), *E. dubiosa* Stempffer & Bennett (Tanganyika). Also describes as new *Iolaphilus henryi* (Uganda, Kiegezi, Kayonza Forest), *I. maritimus usambara* (Tanganyika, Usambara Mts., Amani); *Epamera silanus alticola* (Amani). [P. V.]

Stempffer, H., & N. Bennett, "Révision du genre *Pentila Westwood* (Lep. Lycaenidae)" [in French]. *Bull. Inst. franç. Afr. noire (A)*, 23: 1098–1211, 146 figs. "1961" [1962]. Important revisionary study on the African genus *Pentila*, with some descriptions of new species and subspecies: *P. nyassana benguellana* (Angola, Calweha R.), *P. pseudorotha* (Brit. Cameroon, Mamfe), *P. umangiana fontainei* (Belgian Congo, Uele), *P. occidentalium gabunica* (Gaboon, Azingo L.), *P. nigeriana* (Nigeria, Ogoja), *P. landbecki* (Belgian Congo, Upper Kasai Distr.), *P. carcassoni* (N. Nyasaland, Mkuwazi, forest reserve), *P. cloetensi ueleensis* (Belgian Congo, Uele), *P. camerunica* (Brit. Cameroon, Mamfe). [P. V.]

Stempffer, H., & T. H. E. Jackson, "A note on the Rhopalocera of Bugalla Island, Sesse Isles, Uganda." *Proc. R. ent. Soc. London (B)*, 31: 33–37. 1962. Stempffer describes as new *Deudorix (Virachola) lorisona sesse, Anthene sylvanus bugalla*, & *Thermoniphas togara bugalla*. List of 100 other butterfly spp. The islands have been isolated for less than 300,000 years; the spp., except for the three lycaenids, are similar to mainland spp. [P. B.]

Štěrba, Vladimir, "Beitrag zur Kenntnis von *Pieris bryoniae* O. in den Westkarpaten" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 130–134, 2 figs., 1 map. 1961. Further records of this sp. in Carpathians with discussion of variation & racial status. [P. B.]

Sterzl, Otto, "Der Formenkreis von *Cidaria variata* Schiff." [in German]. *Ent. Nachrichtenbl.*, Vienna, 8, no. 8: 1–4. 1961. Review of morphological & biological characters of *C. variata, C. cembrae, C. obeliscata*, & *C. stragulata*. [P. B.]

Sterzl, Otto, "*Lythria purpuraria* L. und *L. purpurata* L., zwei schwer unterscheidbare Arten" [in German]. *Ent. Nachrichtenbl.*, Vienna, 9, no. 8: 1–6. 1962. Distinguishes these two spp. & *L. plumularia*. [P. B.]

Sutton, S. L., "South Caspian insect fauna 1961." *Ann. & Mag. nat. Hist.*, ser. 13, 6: 353–374, 1 pl., 8 figs. 1964. Describes as new *Meharia tancredii* (Meyan Kaleh peninsula, N. Iran); *Oxytrypia stephania* (Firizkuh col., 7,000 ft., Elburz Mts., Iran). Discussion of *Rhodometra antophilaria* & related spp. Annotated list of Lepidoptera collected. [P. B.]

Svensson, Ingvar, "Nordiska *Bryotropha*" [in Swedish; English summary]. *Flora og Fauna*, 68: 61–69, 37 figs. 1962. Describes all Scandinavian *Bryotropha*, with figures of wings & genitalia. [T. W. L.]

Szabó, Richárd, "The forms of *Plebeius sephirus* Friv. in the Middle Danubian Basin" [in Hungarian; English summary]. *Folia ent. hung.*, s.n., 7: 29–39. 1954. Describes the Middle Danubian populations, of which two sspp. are described as new: *P. s. proximus* (Kolozsvár) & *P. s. kovacsi* (Fót). In the region of Deliblato in N. Yugoslavia lives *P. s. uhryki* Rebel. [J. M.]

Szabó Richárd, "The lycaenids of Hungary" [in Hungarian; English summary]. *Folia ent. hung.*, s.n., 9: 235–361, 5 figs. 1956. Monographic study on Hungarian

Lycaenidae with a number of new sspp. *Maculinea alcon curiosa* (Bükk Mts., N. Hungary); *Lycaeides argyrognomon argyropeza* (Hungary); *Plebeius sephirus foticus* (Fót); *Aricia agestis pelorion* (Hungary); *Lysandra thersites pergrata*; *Lycaena virgaureae pyronitens, L. dispar hungarica, L. hippothoe sumadiensis* (District Somogy), *L. alciphron cumanicus* (Peszér). Some of new sspp. without exact locality. In the English summary a short differential diagnosis only is given. Some results are confusing, e.g., *Maculinea arion* ssp. *vagula* n. and ssp. *animula* n. "cannot be separated geographically from each other." [J. M.]

Tilden, J. W., "Certain comments on the subspecies problem." *Syst. Zool.*, 10: 17–23. 1961. Defends the use of this category, with examples of its value in Lepidoptera. [P. B.]

Tilden, J. W., "An analysis of the North American species of the genus *Callophrys*." *Jour. Res. Lepid.*, 1: 281–300, 2 pls., 6 maps. 1963. Describes as new *C. lemberti* (West above Tioga Pass, Yosemite National Park, Calif.). Review of characters & distribution of the seven spp. of *Callophrys* (s. str.) in North America, & comparison of characters with those of *C. rubi, Incisalia augustinus, Mitoura siva,* & *Sandia macfarlandi.* [P. B.]

Tilden, J., "Two species of Hesperiidae previously unrecorded from the United States." *Jour. Lepid. Soc.*, 18: 214–216. 1964. *Vidius perigenes* and *Lerodea dysaules* in southern Texas.

Tilden, J. W., "*Urbanus procne* and *Urbanus simplicius* (Hesperiidae)." *Jour. Lepid. Soc.*, 19: 53–55. 1965.

Tite, G. E., "A new species of the genus *Cacyreus* (Lepidoptera, Lycaenidae)." *Entomologist*, 94: 112–113, 5 figs. 1961. Describes as new *C. ethiopicus* (25 km. N. of Quiha, Ethiopia). [P. B.]

Tite, G. E., "The *Lepidochrysops ortygia* complex (Lepidoptera: Lycaenidae)." *Entomologist*, 97: 1–7, 1 pl., 11 figs. 1964. Describes as new *L. oreas* (Simon's Town, Cape Province), *L. wykehami* (Kamieskroon, Little Namaqualand). *L. australis* (Caledon District, Cape Prov.), *L. methymna dicksoni* (Tygerberg Hills, Cape Prov.); redescribes *L. ortygia.* [P. B.]

Toll, Sergiusz, "Glyphipterygidae, Douglasidae" [in Polish]. *Klucze do Oznacz. Owadow polski*, 27, parts 39–40 (no. 16): 50 pp., 120 figs. 1956. See review in *Journal*, 15: 132.

Toll, Sergiusz, "Micropterygidae, Eriocraniidae, Krótkowąsy—Hepialidae" [in Polish]. *Klucze do Oznacz. Owadow polski*, 27, part 2–4 (no. 29); 49 pp., 13 figs. 1959. See review in *Journal*, 15: p. 132.

Toll, Sergiusz, "Studien über die Genitalien einiger Coleophoridae XV" [in German; Russian & Polish summaries]. *Acta zool. cracov.*, 4: 121–130, 7 pls. 1959. New spp. are described: *Coleophora zukowskii* (Upszar-Massiv, Pieniny Mts., S. Poland), *C. scabrida* (Ohrid, S. Yugoslavia), *C. s. polonica* (Czorsztyn, Pieniny Mts.), *C. macedonica* (Ohrid), C. *pseudodirectella* (Cracow, S. Poland). [J. M.]

Toll, Sergiusz, "Tischeriidae" [in Polish]. *Klucze do Oznacz. Owadow polski*, 27, part 6 (no. 30): 21 pp., 46 figs. 1959. See review in *Journal*, 15: 132.

Toll, Sergiusz, "Studien über die Genitalien einiger Coleophoridae. XVIII (Lepidoptera)" [in German; Polish & Russian summaries]. *Ann. zool. Polska Akad. Nauk*, 19: 209–227, 44 figs. 1961. Describes as new *Coleophora namangana* (Namangan, Fergana), *C. fergana* (Margelan, Fergana), *C. impalella* (Krasnoarmiejsk), *C. paradoxella* (Amurland), *C. uralensis* (Uralsk), *C. kuznetzovi* (Kondara, Tadzhikhsk SSR), *C. gerasimovi* (Osh, Fergana). Compares last two with *C. tadzhikella.* [P. B.]

Toll, S., "Studien über die Genitalien einiger Coleophoridae XX. Beschreibung neuer Coleophoridae aus Österreich, Bulgarien, Spanien und Portugal" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 161–168, 23 figs. 1961. Describes as new *Coleophora glaseri* (Wolkersdorf, Hochleitenwald, Austria), *C. ochroflava* (Bulgaria), *C. soffneriella* (Bulgaria), *C. albarracinica* (Valdovecar, Albarracin, Spain), *C. monteiroi* (Montalegre, Portugal). [P. B.]

de Toulgoët, H., "Description d'arctiides malgaches nouvelles (Lep.) (13ᵉ note)" [in French]. *Bull. Soc. ent. France*, 66: 39–42, 1 pl. 1961. Description of new arctiids from Madagascar: *Phryganopteryx viettei* (Nossi-bé); *Spilarctia pseudambrensis* (Ambre Mt.); *Fodinoidea pluto* (Ambre Mt.); and description of the ♀ of *Asota diastropha* (A. E. Prout). [P. V.]

de Toulgoët, H., "Description de Nolinae nouveaux de Madagascar (Lep. Arctiidae) (12ᵉ note)" [in French]. *Mém. Inst. scient. Madagascar, (E)*, 12: 191–206, 20 figs., 1 pl. "1961" [1962]. Descriptions of new Nolinae from Madagascar: *Roeselia nigromixtalis* (E. Madagascar, Perinet), *R. nudalis* (Integral Natural Reserve 3), *R. saalmuelleri* (Perinet), *R. medialis* (central Madagascar, Ankaratra Mts.), *R. erythrinalis* (central Madagascar, Betsileoland), *R. arcanalis* (E. Madagascar, Anosibe Road), *R. palpalis* (Betsileoland), *R. bilineatalis* (Anosibe Road), *R. rubiginealis* (E. Madagascar, Ranomafana), *R. convexalis* (Betsileoland), *R. c. griveaudalis* (central Madagascar, Andringitra Mts.), *R. infuscatalis* (Ranomafana), *R. dilutalis* (Perinet), *R. rufomixtalis* (central Madagascar, Ampolomita), *R. mediolinealis* (Ampolomita), *R. vieui* (E. Madagascar, Moramanga), *R. funebralis* (E. Madagascar, Italaviana), *R. modestalis* (E. Madagascar, Andranomandevy), *R. paulianalis* (Moramanga), *R. inexpectalis* (S.W. Madagascar, Lambomakandro Forest); *Celama triangulalis* (Perinet). [P. V.]

Trehan, K. N., & D. K. Butani, "Life-history, bionomics and control of jowar stem-borer (*Chilo zonellus* Swinhoe). *Curr. Sci.*, 17: 127. 1948. Short note justifies full species status of *C. simplex* & *C. zonellus*; brief life history. [J. D.]

Trehan, K. N., & Dhamo K. Butani, "Systematic position of *Chilo zonellus* Swinhoe and chaetotaxy of its larvae." *Indian Jour. agric. Sci.*, 20: 79–85, 3 pls. 1950. Find *C. zonellus* & *C. simplex* distinct, but believe only former occurs in India. [J. D.]

Tremewan, W. G., "On some type specimens of the genus *Zygaena* Fabricius, including the lectotype selection of *Zygaena felix* Oberthür, Lepidoptera: Zygaenidae." *Ent. Rec. & Jour. Var.*, 74: 125–130, 1 pl. 1962. Notes on types of 14 names (including aberrations) with figures of 13. [P. B.]

Tremewan, W. G., "A new subspecies and further records of the genus *Zygaena* Fabricius (Lepidoptera: Zygaenidae) from south-west France and Spain," *Ent. Rec. & Jour. Var.*, 75: 251–254. 1963. Describes as new *Z. occitana burgosensis* (Ona, Burgos, 2,000 ft.). Records of 20 other forms. [P. B.]

Tremewan, W. G., "Notes on *Zygaena* species from south-west France and Spain with descriptions of three new subspecies (Lepidoptera: Zygaenidae)." *Ent. Rec. & Jour. Var.*, 75: 1–10, 1 pl. 1963. Describes as new *Z. ignifera diezma* (Diezma, Granada, 4,000 ft.), *Z. lavandulae huescae* (P. de S. Barbara, Huesca, 3,300 ft.), *Z. trifolii pajini* (Riano, Leon, 3,500 ft.). Notes on 28 other races belonging to 14 spp. [P. B.]

Tremewan, W. G., "The type specimens of *Zygaena ledereri* Rambur and *Z. pennina* Rambur, Lepidoptera: Zygaenidae." *Ent. Rec. & Jour. Var.*, 75: 166–168, 2 figs. 1963. Former is ssp. of *Z. punctum* (n. syn.: *contamineoides*); latter is junior synonym of *Z. contaminei*. [P. B.]

Tremewan, W. G., "The identity of *Zygaena algira* Boisduval, 1834 (Lepidoptera, Zygaenidae)." *Ent. Rec. & Jour. Var.*, 76: 35–36, 1 pl. 1964. North African sp., usually credited to Duponchel, was first described by Boisduval. Lectotype & genitalia are figured. [P. B.]

Tremewan, W. Gerald, "The *Silvicola* Burgeff group of the genus *Zygaena* Fabricius (Lep. Zygaenidae)." *Ent. Rev. & Jour. Var.*, 76: 1–10, 46–54, 75–82, 1 map. 1964. Review of the characters & geographic variation in species of this palearctic group. Species included are *gallica, giesekingiana, mana, rjabovi, teberdica,* and the highly polytypic *nevadensis, romeo,* & *osterodensis* (*scabiosae* auctt.). Proposes *Z. romeo faitocola* n.n. for *Z. r. faitensis* Holik, preoccupied. Some new synonymy. [P. B.]

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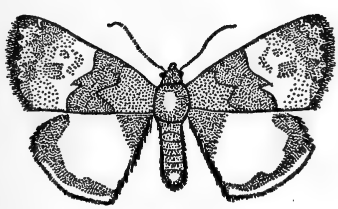

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31 May 1966

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Journal of The Lepidopterists' Society

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THE SYNONYMY AND SYSTEMATIC POSITION OF SOME TEXAS LYCAENIDAE

Harry K. Clench
Carnegie Museum, Pittsburgh, Pennsylvania

Three species of North American hairstreaks remained systematically unplaced when I prepared the account of that group in Ehrlich & Ehrlich's "How to know the butterflies": *"Strymon" laceyi* Barnes & McDunnough; *"Strymon" facuna* Hewitson; and *"Strymon" buchholzi* Freeman. All three are primarily Mexican and barely reach the United States in southernmost Texas. All are, furthermore, quite rare in collections.

Thanks to Mr. Roy O. Kendall of San Antonio, Texas, and to Mr. H. Avery Freeman of Garland, Texas, I have been able to study Texas specimens of the first two of these species, with the systematic and synonymic results set forth below. Remarks are also added on another misunderstood species from the same region.

Strymon alea (Godman & Salvin)

Thecla alea Godman & Salvin, 1887, Biol. Centr. Amer. Rhop., 2: 95, pl. 58, figs. 10, 11 (Tres Marías Ids., Nayarít, Mexico); Hoffmann, 1941, An. Inst. Biol. Mexico, 11: 720.

Callicista laceyi Barnes & McDunnough, 1910, Canad. Ent., 42: 365 (Del Rio, Texas). New Synonymy.

Strymon laceyi, Stallings & Turner, 1946, Ent. News, 57: 49; Freeman, 1950, Field & Lab., 18: 68; Klots, 1951, Field Guide Butterflies, 282; Clench, 1961, *in* Ehrlich & Ehrlich, How to Know the Butterflies, 219, fig. 422.

Thecla (*Callicista*) *columella* (not Fabricius, 1793), Holland, 1931, Butterfly Book, rev. ed.: 240 (in part).

The male genitalia show a single acuminate cornutus in the aedeagus, exserted with the vesica in the specimen examined, and numerous small basally directed teeth on the tips of the valvae, characteristic of true *Strymon*. There is little question that this is the correct generic placement of the species. The tip of the aedeagus is somewhat upturned.

Strymon alea appears to exist in two seasonal forms (cf. also Stallings

& Turner, 1946). The summer form, represented by the illustration of *alea* in Godman & Salvin, by the type of *laceyi*, and by the single Mazatlán female cited below, has a fairly even grayish ground color below, the pm lines edged inwardly with red, a more or less distinct reddish cap on the "Thecla spot" below, and probably a more extended pale marginal area on the hindwing above in both sexes. The winter form (Figs. 3, 4) is represented by a pair loaned for study by Mr. Kendall: the male from San Patricio Co. (April) and one of the two Comal Co. (November) females in the list below. In these specimens the ground of the underside is darker gray between the pm line and the postbasal spots on the hindwing, much lightened distad of the pm line, lacks red edging on the pm line, the cap on the "Thecla spot" is faintly ochreous, and the pale marginal area of the hindwing above is reduced (particularly in the male) to hardly more than pale bluish rings around the subterminal spots.

The synonymy is, I believe, correct, though the problem is complicated by the description of the two names from widely separated localities, by the seasonal differences just described, and especially by the rarity of the species and the consequent insufficiency of comparative material. The possibility that *laceyi* may be subspecifically distinct from *alea* can be neither excluded nor affirmed at this time.

The following records are all that are known to me of the species.

TEXAS: Del Rio (Val Verde Co.), vii.1909 (1♀, type of *laceyi*); Pharr (Hidalgo Co.), v, x, xii (Stallings & Turner, 1946; Freeman, 1950; Klots, 1951); Lake Corpus Christi State Park (San Patricio Co.), 22.iv.1961 (1♂, R. O. Kendall); Landa Park, New Braunfels (Comal Co.), 7.xi.1964 (2♀, R. O. Kendall).

MEXICO: Islas Tres Marías (Nayarít) (type of *alea*); 16 mi N of Mazatlán (Sinaloa), 29.x.1961 (1♀, Cary-Carnegie Museum Exp.); Córdoba (Veracruz) (W. Schaus); (Godman & Salvin, 1887); Tampico (Tamaulipas), 21–22.vi.1964 (1♀, H. A. Freeman); Cd. Mante (Tamaulipas), 21–22.vi.1964 (1♂, 1♀, H. A. Freeman); states of Jalisco and Michoacan (Hoffmann, 1941).

CALLOPHRYS (CYANOPHRYS) GOODSONI (Clench)

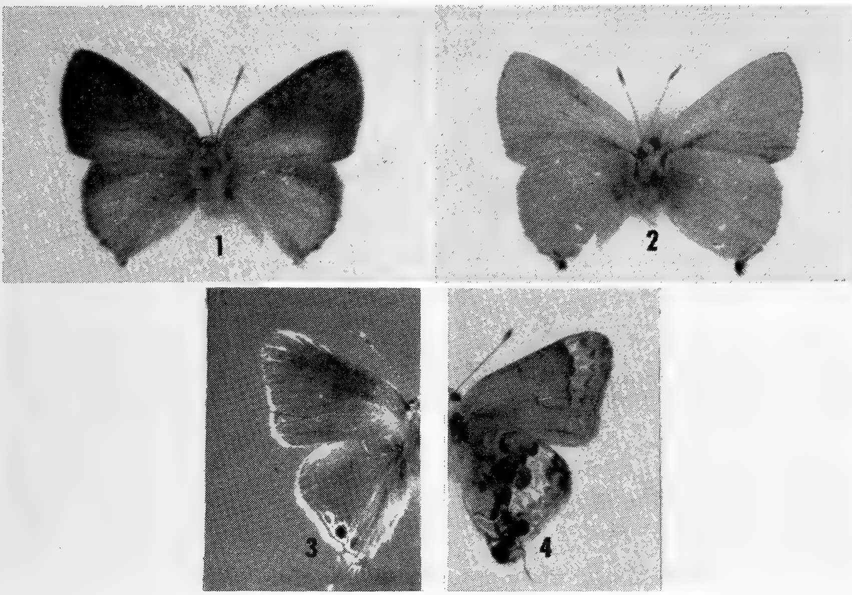
Thecla goodsoni Clench, 1946, Entomologist, 79: 186 (Tegucigalpa, Honduras).

Thecla (or *Strymon*) *facuna* (not Hewitson, 1877), Freeman, 1950, Field & Lab., 18: 14, 72; Klots, 1951, Field Guide Butterflies, 281; Clench, 1961, *in* Ehrlich & Ehrlich, How to Know the Butterflies, 220.

Strymon pastor facuna, dos Passos, 1964, Syn. List. Nearctic Rhop., 56.

Compare: *Thecla facuna* Hewitson, 1877, Ill. Diurn. Lep. Lycaenidae, 202, pl. 80, figs. 661, 662.

The Texas records of *facuna* given by Freeman and Klots were based on three specimens taken by Mr. Freeman and determined as *facuna* by W. P. Comstock and E. I. Huntington. Hewitson's figures of *facuna* indeed resemble the present species closely, every bit as much as his other



Figs. 1, 2. *Callophrys goodsoni* Clench, male, Hidalgo Co., Texas; 1, upperside; 2, underside. Figs. 3, 4. *Strymon alea* (Godman & Salvin), winter form; 3, male upperside, San Patricio Co., Texas, April; 4, female, underside, Comal Co., Texas, November. (Photographs by L. D. Miller).

figures resemble their respective species. On looking into the matter I became all but convinced that *goodsoni* would have to fall to *facuna*. Accordingly, I wrote to Mr. G. E. Tite of the British Museum Department of Entomology to ask his help. His prompt and detailed reply included a careful comparison of external characters of *goodsoni* and *facuna*, based on the types of each (among other material), and a drawing of the male genitalia of the type of *facuna*, reproduced here in Fig. 7.

In external features they differ (according to Mr. Tite's notes) as follows: in *facuna* males the blue of the upperside is shining and rather dark, deeper than in Hewitson's figure, while the blue of *goodsoni* male is pale and not shining; the male of *facuna* has no scent pad on the forewing, while *goodsoni* has; the green of *facuna* below has a tawny reflection absent in *goodsoni*; the fuscous area on the inner margin of the forewing underside reaches halfway to Cu_2 in *facuna*, all the way in *goodsoni*; the white pm spots of the hindwing below are few but present in *goodsoni*, completely absent in *facuna*; the tornus is less produced in *facuna* than in *goodsoni*.

The male genitalia of *facuna* (Fig. 7) show clearly how distinct it

really is from *goodsoni* (Fig. 6). Particularly notable is the virtual absence of a saccus, the apically divergent valvae, the simple, acuminate, widely separated cornuti. By this configuration *facuna* is clearly no *Callophrys* at all and, indeed, cannot yet be assigned to any known genus. It must be a rare species, for there are only three specimens in the British Museum: the type (with no data), and two others both labeled as from Venezuela, one from the Godman & Salvin collection, one from the Felder collection.

The type of *Callophrys goodsoni* is in the British Museum also, but unfortunately it lacks its abdomen. This, however, is of no great moment, for in its external characters *goodsoni* is unlike any other member of the subgenus and is unmistakable: the lack of tails; strongly suppressed pattern elements below; small size; pale lavender blue of the male above; extremely broad fuscous apex of the male forewing above, reaching basad about to cell-end. Several Yucatan specimens are at hand and the genitalia of one of them (Fig. 6) were found identical to those of the Texas specimen loaned by Mr. Freeman. Since this species has never been figured, I am taking the occasion to illustrate the Texas male (Figs. 1, 2).

Callophrys goodsoni is a rare species and has been seen or recorded only from the following localities.

TEXAS: Near Pharr (Hidalgo Co.), 23.vii, 9.viii.1945 (H. A. Freeman).

MEXICO: Atoyac (Veracruz) (Clench, 1946); 2 mi NE Catemaco, 1,100 ft (Veracruz), viii (G. N. Ross); Pisté (Yucatán), x, and Chichén Itzá (Yucatán), ix, vi (all E. C. Welling).

HONDURAS: Tegucigalpa (type) and San Pedro Sula (Clench, 1946).

COSTA RICA: [Mt.] Irazu, 6,000–7,000 ft (Clench, 1946: an atypical female).

CALLOPHRYS (CYANOPHRYS) MISERABILIS Clench

Thecla pastor (not Butler & Druce, 1872), Barnes & McDunnough, 1913, Canad. Ent., 45: 183; Holland, 1931, Butterfly Book, rev. ed., 228 [pl. 64, figs. 14, 15, represent *longula* (= *pastor*), not *miserabilis*; erroneously listed as from Arizona].

Strymon pastor (not Butler & Druce, 1872), Stallings & Turner, 1947, Ent. News, 58: 39–40; Freeman, 1950, Field & Lab., 18: 66; Klots, 1951, Field Guide Butterflies, 139.

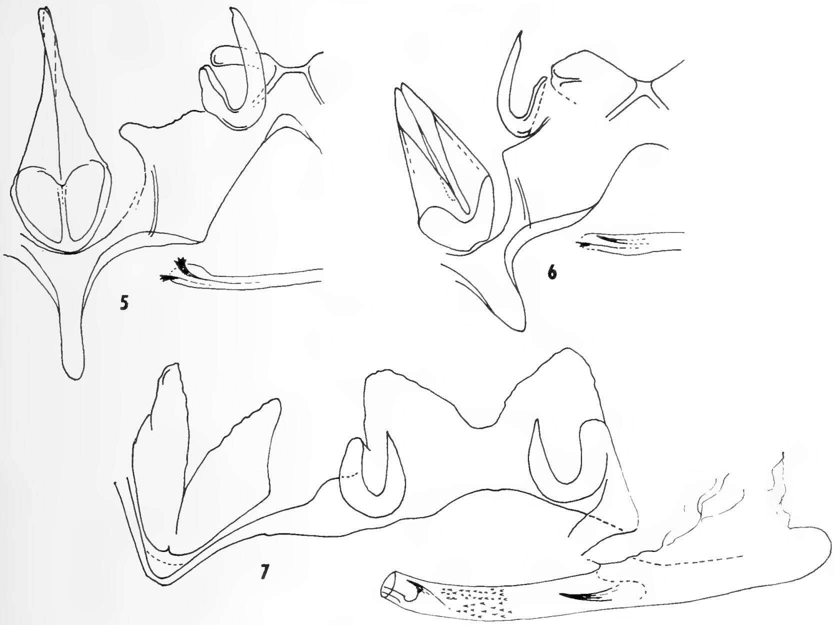
Strymon pastor pastor (not Butler & Druce, 1872), dos Passos, 1964, Syn. Cat. Nearctic Rhop., 56 [species name erroneously dated 1869].

Thecla miserabilis Clench, 1946, Entomologist, 79: 156 (Rincon, 2,800 ft, Guerrero, Mexico).

Callophrys (Cyanophrys) miserabilis, Clench, 1961, *in* Ehrlich & Ehrlich, How to Know the Butterflies, 211, fig. 402.

Callophrys (Callophrys) miserabilis, dos Passos, 1964, Syn. Cat. Nearctic Rhop., 59.

The subgenus *Cyanophrys* is composed of a number of subtropical and tropical species, many of which are extremely similar to one another.



Figs. 5–7. Male genitalia of Theclinae; 5, *Callophrys miserabilis* Clench; 6, *Callophrys goodsoni* Clench, Yucatan, Mexico; 7, "*Thecla*" *facuna* Hewitson, type (in British Museum, without data).

They have given much trouble to systematists and the result, particularly in the present instance, is a great deal of confusion.

The first species to be described in the group of concern here was *longula* Hewitson (1868, Descr. Lycaenidae: 34). Hewitson appears to have lost the specimen he described, for a few years later (1877, Ill. Diurn. Lep. Lycaenidae: 200, pl. 80, figs. 651–654) he illustrated as *longula* quite a different species, and this became the accepted sense of the name. Butler & Druce (1872, Cist. Ent. 1: 105; see also Butler, 1873, Lep. Exot.: 157, pl. 57, fig. 5) redescribed the original *longula* under the name of *pastor*.

In 1913 Barnes & McDunnough identified a series of specimens taken in the Brownsville area of southeastern Texas as *pastor*, introducing this name into North American lists for the first time.

In 1944 (Bull. Mus. Comp. Zool. 94: 239) I pointed out the discrepancy between Hewitson's later use of the name *longula* and his original description of it, gave the name *pseudolongula* to the later one and synonymized *pastor* to true *longula*. By virtue of this, the United States record

of "*pastor*," assuming its correct identification, should have become *longula*, and in 1946 (Entomologist 79: 190) I actually did use the name *longula* so, reporting that it occurred in Texas. This was a mistake, for the identification of Texas specimens as *pastor*, by Barnes & McDunnough, appears to have been wrong. I have not seen the actual specimens so determined by these authors, but from their descriptive remarks I believe these specimens are of the same species as every other Texas specimen that I have seen purporting to be "*pastor*." All belong to the species described in 1946 as *miserabilis*.

C. miserabilis is not uncommon in southeastern Texas and it ranges widely through Mexico south to Costa Rica. The male genitalia are shown in Fig. 5.

It may be of help to summarize briefly the more important characters that discriminate the several species here discussed:

C. longula (= *pastor*). Frons brown; hindwing tailed; ♂ above brilliant morpho-blue; hindwing underside with subterminal maroon spots present.

C. pseudolongula. Frons brown; hindwing tailed in ♀, tailed or tailless in ♂; ♂ above brilliant morpho-blue; hindwing underside without subterminal maroon spots.

C. miserabilis. Frons brown; hindwing tailed; ♂ above dull steel blue; hindwing underside with subterminal maroon spots present or absent.

C. goodsoni. Frons green; hindwing tailless; ♂ above with pale lavender blue on each wing; hindwing underside without subterminal maroon spots.

The following conclusions summarize the situation as it now stands with regard to the subgenus *Cyanophrys* north of Mexico.

1. There are two species of *Cyanophrys* known from the United States (southeastern Texas): *goodsoni* and *miserabilis*.

2. So far as I can tell all records of "*pastor*" from Texas refer to *miserabilis*.

3. The name *pastor* is a synonym of *longula* Hewitson, a species not known to occur in the United States.

4. Despite Holland's statement, no member of the subgenus is known from Arizona. His figures appear to represent true *longula* (= *pastor*), but the figured specimens cannot be located in the Carnegie Museum collection and were presumably borrowed by Holland for illustration.

ITINERARIES OF THE WHEELER SURVEY NATURALISTS: HENRY WETHERBEE HENSHAW

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Some years ago I started to prepare detailed studies of the movement of the naturalists who had been assigned to the Wheeler Surveys west of the 100th meridian. Two of these studies have been published, for Theodore L. Mead (Brown, 1956) and for Ferdinand Bischoff (Brown, 1958). Having particular need for precise data about the wanderings of H. W. Henshaw[2] in connection with a study of the types of the butterfly names proposed by William Henry Edwards, I have gathered together my notes and put them in form for publication.

Expedition of 1872

The official tally of specimens collected by the expedition of 1872 makes no mention of any butterflies collected. In matter of fact it suggests that practically all of the material gathered had been destroyed by a series of mishaps. The truth is that a great many of the specimens survived these and were turned over to specialists for study.

In a preliminary report for the field season of 1872 (Yarrow and Henshaw, 1874: 52–55), there is a good summary of the work done. During the latter half of July and the first week or so of August, Henshaw made a large collection of insects, especially Coleoptera. Other extensive collections were made at Fillmore, Beaver, Toquerville, and Meadow Creek. Unfortunately some bottles of specimens were lost on the trail from Shonesburgh to Toquerville. A fire at Sevier destroyed most of the Lepidoptera that had been collected.

The great bulk of the butterflies collected by the Wheeler Survey parties and labelled "So. Utah." came from the trek taken by Acting Assistant Surgeon H. C. Yarrow and his naturalist-assistant H. W. Henshaw from Provo to Washington and St. George, Utah, and return. Apparently each of these naturalists concentrated his efforts on certain groups of animals. Yarrow primarily collected vertebrates, other than birds. Henshaw divided his time between birds and insects.

The development of a trace and timetable for Henshaw was not difficult but was laborious. He made very precise records of the bird skins

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[1] This study was supported in part by N.S.F. Grant GB-2741.

[2] An autobiography of Henshaw will be found in *Condor*, 21: 102–107, port., 165–171, port., 177–181, 217–222; 22: 3–10, 55–60, 95–101 (1919–1920).

he collected for Baird. By carefully going over these data and entering the field numbers and localities on a master calendar a reasonably complete record of Henshaw's travels was obtained.

Once the calendar was completed it became evident that numerous data in the register of specimens collected (Volume 5) were in error. These errors all can be attributed to misreading of the manuscript by the printer and proofreaders. The most frequent type of error is use of the wrong month for the collection date of a specimen. This caused certain field numbers to be out of place. When the field number was put into proper sequence the discrepancy in locality disappeared. Unless otherwise noted, all of the data in the following table is based upon specimens, their field number, and date and locality of collection. The exceptions are drawn from the first volume of the series, The Geographical Report, volume 1 (Wheeler, 1889). The Zoological Report, volume 5, was published much earlier (Henshaw, 1875).

From Dr. Yarrow's account for 1872 (5: 16–18) it is learned that the two naturalists worked together from the time the party formed around the middle of July in the vicinity of Salt Lake City until the parties moved out of Provo on the 10th of August. At that time Dr. Yarrow joined Lieutenant Hoxie's party and circled far westward into Nevada, thence into the southwestern part of Utah. Mr. Henshaw joined Lieutenant Wheeler's party and moved in a generally southwestward direction to a rendezvous with the Hoxie Party at Toquerville, Utah. From there on the two worked together until the party disbanded in December at Provo.

Apparently the two naturalists used a common series of field numbers for the time they were together in July. These range up to 151. This series was then continued by Yarrow for the rest of the season. Henshaw began an independent series on July 31st with his collection from Provo Canyon. The double series has caused some problems and confusion!

In a footnote (1889: 46) Wheeler outlined his travels during this field season. From it I gather that during the assembly period at Salt Lake City several excursions were made. Field numbers 1–11, for which I have no information, may apply to lost material collected during this period. From the camp near Salt Lake City Wheeler visited the mining districts about Parley's Park. Later he went to Little Cottonwood Canyon and returned via the heads of American Fork Canyon and Big Cottonwood Canyon. Then the entire party moved to Provo.

Wheeler's own itinerary outlines the main party travel until he broke away at St. George: "From camp near Salt Lake City to mining districts about Parley's Park and return; to Little Cottonwood Canyon and return,

via heads of American Fork and Big Cottonwood Canyon; thence to Provo, Utah; thence to Spanish Fork via Provo Valley and Canon and Strawberry Valley; thence to Thistle Valley via Spanish Fork; thence to Utah Lake Valley and circuit to Sam Pitch Valley via Nephi; thence to the eastward across the range and along flanks of Castle Valley and returning to Sam Pitch Valley (without trail); thence to Nephi via Gunnison; thence to Fillmore; thence to Beaver and Panquitch via Parowan; thence via Sevier Plateau and head of Virgin River Valley and Canon to Toquerville; then to Saint George; (all in Utah) . . ." (1889: 46).

Aug. 10, "left Provo and camped that night opposite the mouth of the South Fork of the Provo River" (1889: 46–47).

Aug. 13, "The route from Provo to Strawberry Valley follows Daniel's Creek to its source . . . thence . . . to the head of Strawberry Creek" (1889: 47).

Aug. 14, 15 and 16, "A partial rendezvous was made on Soldier's Fork of Spanish Creek, and the march continued to Sam Pitch Valley and camp made near a settlement called Wales." (1889: 48).

Aug. 25, "A detour to the eastward of the Sevier Valley was planned and a crossing made from near the source of Thistle Creek, about 1½ miles from which a summit is reached that either forms the immediate head or is in close proximity thereto of six streams, viz: Thistle Creek, Soldier's Fork, Strawberry Creek, White River, San Rafael, and Sam Pitch Creeks. The tortuous line of these several water divides was followed in a southeasterly direction until a trail, evidently leading in the direction of Castle Valley, was met and followed." (1889: 48).

According to Henshaw (1875: 134) the season officially opened on the 15th of July at Provo. Here he and Yarrow used field numbers from 12 to 151 between that date and the 30th. The numbers for the stay at Provo are not in sequence with the dates. It seems that the specimens for this period were numbered somewhat haphazardly. There are several obvious errors. A specimen of *Parus atricapillus septentrionalis* Harris bears a number 26 and is dated July 1, 1872. It probably was taken on August 1 of that year. A *Passerculus savanna alaudinus* Bonpland (no. 123 "July 20, 1872," Thistle Valley, Utah) probably was taken on August 23 at Thistle Valley where no. 124, the same species, was taken. Five specimens of *Carpodacus frontalis* (Say) numbers 21, 41, 42, 52, and 124 bearing dates between July 25 and August 2, 1872, are labelled "Washington, Utah." So far as I can learn the only visit to Washington, Utah, was made in October of that year. Four specimens of this finch were collected at Washington, Utah, on October 23, 1872.

The numbers for this station run from 322, 333 to 360 and all are Yarrow specimens. I believe that the "Washington" is in error and the five specimens noted hailed from the vicinity of Provo.

After Yarrow left to join Hoxie's party, Henshaw's numbers ran rather smoothly. The main party stayed at Provo until August 10th, and then started southwesterly toward the rendezvous at Toquerville. For the remaining period at Provo, Henshaw used his own series of numbers. The dates and locations of his collection there are given in Table I.

TABLE I

Date	Numbers	Location
24 July		Provo, Utah
31 July	119, 180	Provo, Utah
"	5 to 10	Provo Canyon
1–3 August	11 to 49	Provo
9 August	61	Hobble Canyon
"	62	Provo
11 August	64	Wasatch Mountains, Provo Canyon
12 August	69 to 74	Daniel's Canyon
"	72	Wasatch Mountains
13 August	80 to 82	Strawberry Valley
16–17 August	95 to 103	Wasatch Mountains
18 August	109	Thistle
20 August	112–115	Fountain Green
"	123	Thistle Valley
22 August	122	Fairview
23 August	124	Thistle Valley
25 August	133	Wasatch Mountains
5 September	141	Gunnison
"	143–145	Salina
7–8 September	147–152	Gunnison
8 September	153	Wasatch Mountains
10 September	154–160	Grass Valley
14 September	163–164	Otter Creek
15 September	165	Harmony
17–18 September	167–181	Panquitch
19 September	184	Otter Creek
30 Sept.–2 Oct.	188–211	Rush Lake
3 October	211–215	Iron Springs
"	216–217	Mormon Springs
4–5 October	220–236	Iron Springs
5–6 October	237–252	Iron City
6 October	253–255	Toquerville
6–8 October	256–265	Iron City
9–10 October	266–269	Harmony
10 October	270–272	Toquerville
"	273–275	Washington
"	276–277	Iron City
11–12 October	280–282	Harmony
13–15 October	283–306	Toquerville

Table II

Date	Numbers	Location
16–21 October	310–330 (ex 322)	Toquerville
22–24 October	322, 333–360	Washington
22 October	364	St. George
26–27 October	363–369	Cove Creek
28 October	370	Pine Valley
"	371–373	St. George
31 October	375	Rush Lake
"	376–378	Beaver
3–11 November	379–397	Beaver
12 November	389–401	Pine Creek
13–15 November	402–409	Cove Creek
15–18 November	410–426	Fillmore
25 Nov.–3 Dec.	429–491	Provo

There are two numbers in this run that need comment. For No. 100 "Panguitch" 17 August, the locality is obviously incorrect, the number and date suggest Wasatch Mountains; and for No. 102 "Provo" 17 August, the locality probably is wrong, the date and number suggest Wasatch Mountains.

All of the field numbers refer to bird skins. The missing numbers were those for insect collections and a few for vertebrates other than birds.

From Toquerville through the rest of the season the two parties operated together under Lieutenant Hoxie. During this period the two naturalists worked more or less together but were at times separated. Yarrow's field numbers on the western circuit had run to 312. He seems to have joined in with Henshaw at Toquerville and the two, beginning October 16, used a common series of numbers, a continuation of Henshaw's series (Table II).

Expedition of 1873

In 1873, there were three divisions of the Wheeler Surveys in the field. The first of these, under the direct command of Lieutenant G. W. Wheeler, gathered at Santa Fe, New Mexico. The second was based at Salt Lake City, Utah, and under the command of Lieutenant R. L. Hoxie. The third met at Denver, Colorado, and was commanded by Lieutenant W. L. Marshall. The various parties took to the field around the first of June and disbanded in the first week of December.

H. W. Henshaw received permission to begin his work earlier in the season than did the others. He arrived in Denver early in May. The other two naturalists assigned to Lt. Marshall's division were botanists, John Wolf and Acting Assistant Surgeon J. T. Rothrock. Henshaw

operated almost independently and spent part of his time in the area covered by the Third Division and part of it in the region occupied by the First Division. His principal bases for operation were Denver and Fort Garland in Colorado, Fort Wingate, New Mexico, and Camp Apache, Arizona.

Throughout my study of Henshaw's travels I have found that the data from his bird skins are most reliable. He had been trained by S. F. Baird of the Smithsonian Institution to be very particular about labelling each skin with the date and locality of its capture. By compiling a calendar from these data I have recovered in some detail Henshaw's operation. In doing so I have discovered numerous errors in the listings published in the Zoology volume of the Survey in 1875. During the season of 1873, Henshaw used a little over 1,000 field numbers for his collections.

The Denver Collections

Henshaw arrived in Denver around the 5th of May and had anticipated moving immediately to Fort Garland in the San Luis Valley of Colorado. He was delayed in Denver until May 22nd awaiting arrival of his equipment that had been shipped to him from Boston. During the delay he collected in the immediate vicinity of Denver, expecting every day to be able to take off for Fort Garland. While in the Denver area Henshaw used about 123 numbers, the lowest number used at his next stop, Fort Garland, was 124. Henshaw's field numbers ran consecutively and were not restricted to bird skins.

There are three "Denver" specimens with field numbers in the Fort Garland series. These are 132, 150, 152 listed both in the "Observations" (Yarrow & Henshaw, 1874) and in the "Report" (Henshaw, 1875). In the "Report" there are four Fort Garland numbers credited to that station but given May dates instead of June dates (147, 231, 291, 347) and four Denver numbers and dates credited to "Ft. Garland" or "So. Colo." numbers 9, 20, 62, and 116. On p. 301 of the "Report" No. 119, *Cyanospiza amoena* (Say) is reported without locality. The date and number place it at Denver. The "Observations," p. 63, confirm this.

From Denver to Fort Garland

Henshaw states in the "Report" (1875: 134–5) that he stayed in Denver until the 22nd of May and arrived at Fort Garland on May 24th. To do this in 1873, he probably did as follows: travel by the recently opened railroad from Denver to Pueblo on the 22nd and on the same day take the south-bound stage to Walsenberg, staying the night of the 22nd--23rd at the crossing of the Huerfano River. I know of no stage

that crossed the mountains from Walsenberg to the San Luis Valley at this early date. By leaving Walsenberg on horseback Henshaw could in a day and a half of hard riding gotten to the Fort on the evening of the 24th. The distance is about fifty miles and the trail led over a 9,000-foot pass.

While at Fort Garland Henshaw made two collections at points some distance from the Fort. One of these was made at the Alkali Lakes that terminate the San Luis River in the northern part of the valley. These lakes are about 25 miles northwest of Fort Garland, a good day's ride away and favorite hunting place for the officers. The other was at the summer cavalry camp "on the Rio Grande about 90 miles northeast [sic] of Fort Garland." There is no Rio Grande northeast of Fort Garland. The error in direction appears in both the "Observations" (1874: 70), and the "Report" (1875: 136). The camp was west–northwest of the Fort near the present town of South Fork on the Rio Grande where it emerges from the mountains into the San Luis Valley. Henshaw also spent about a week in camp on the shoulder of Old Baldy, about 12 miles north of the Fort.

Henshaw used 305 field numbers at his Fort Garland base. Of these about 170 apply to bird skins, 20 to clutches of eggs, 13 for nests, and 21 for sterna. About 50 numbers apply to vertebrates other than birds and 50 to invertebrate collections. In general, the material other than ornithological is labelled "Fort Garland." A few of these are labelled from Rio Grande and Alkali Lakes. The following tabulation of dates, field numbers, and localities are as accurate as I have been able to compile (Table III).

I have seen no material that was collected by Henshaw from June 29 through July 1 inclusive. He probably spent this time packing his collections for shipment. He left Fort Garland on July 2, unencumbered, for a fast trip to Fort Wingate in New Mexico.

Table III

Date	Field Numbers	Locality
25 May–29 May	124–197	vic. of Fort Garland
30 May–6 June	198–284	field camp on Old Baldy
7 June	285–301	Fort Garland
8 June–9 June	302–304	en route to cavalry camp
10 June–16 June	305–371	Cavalry camp on Rio Grande
17 June–18 June	372–374	en route to Fort Garland
19 June–20 June	375–387	vicinity of Fort Garland
21 June–23 June	388–414	Alkali Lakes
23 June–28 June	416–428	vicinity of Fort Garland

Fort Garland to Fort Wingate

I have found no indication of how Henshaw traveled from Fort Garland to Fort Wingate. There were open to him several routes: via Walsenberg and stage lines to Santa Fe, then westward on horseback or with a supply train to Fort Wingate; directly south from Fort Garland via the old Spanish Road to Taos and Santa Fe and westward; directly to Fort Wingate via Chama, Pagosa Springs, and south from the vicinity of the present city of Durango. The third route would have been very risky for a lone horseman or a small party. I suspect that he took the old Spanish Road. He did no collecting en route so there is no clue afforded by specimens. He arrived at Fort Wingate on the 12th of July and there joined the Wheeler party. The chief naturalist for that party was C. G. Newberry, Acting Assistant Surgeon, who was a good geologist and general naturalist.

Fort Wingate to Camp Apache

The Henshaw party delayed at Fort Wingate for several days and left for Camp Apache on July 19th. During the week of delay, Henshaw and Newberry made good use of their time. Henshaw's movement from Fort Wingate to Camp Apache can be traced through his specimens.

Comparison of this data with that published as the itinerary of the Wheeler party (1889: 58–74) shows clearly that Henshaw tended to travel in the van or even ahead of the main party. The account alluded to does assist in filling details of the route. From it we know that the main party followed the old wagon road from Fort Wingate to Camp Apache. I have used it and some knowledge of the region to make a trace of the probable route followed (Table IV).

Table IV

Dates	Field Numbers	Locality
13 July–18 July	430–456	vicinity of Fort Wingate, N. M.
19 July	457–462	Nutria, N. M. (a Zuñi pueblo)
23 July–24 July	463–499, 502	"El Morro," Inscription Rock, N. M.
24 July	500–501	Pescao, N. M.
25 July	503–504	Zuñi Pueblo, N. M.
27 July	505 [–508?]	Colorado Chiquito, Arizona
28 July–31 July	no information	
1 August	509–513	Cave Spring, Arizona
2 August–8 August	514–529 [533?]	Camp Apache, Arizona
8 August–12 August	534–568 [577?]	White Mountains, Ariz.
13 August–20 August	no information	
21 August–29 August	578–653 [660?]	Camp Apache, Ariz.

In the above tables I have placed certain field numbers in brackets with a question mark. I believe that these numbers belong with the date and locality noted and were assigned to collections, mostly insects, that I have not been able to trace. Very few of the entomologists who examined and reported upon the material collected bothered to record the field numbers associated with the specimens reported. Ulke, who reported on the Coleoptera, is an exception. Some of the numbers were applied to very mixed lots; 500 is a good example. This was a jar or can of alcoholic specimens and included fish, reptiles, and beetles. The only material that received particular care was the ornithological collection.

I have found no explanation of the hiatus of one week, 13th through 20th of August, during which Henshaw apparently did little or no collecting. He may have been completing preparation of his large collection, he may have been ill, or there may have been some other interruption of his work. The numbers between 568 and 578, which are missing from my records, probably were used on White Mountain insects. Apparently his "White Mountains" locality lay along the East Fork of the White River from Camp Apache to the high land of Baldy and Ord peaks.

Camp Apache to Camp Bowie

Wheeler's party of topographers returned from the White Mountains to Camp Apache on August 30th. On that day Henshaw, who had been at Camp Apache for at least a week and possibly a fortnight, left for the south. He was out a week and returned to Apache, finally heading for Camp Bowie on September 6th. He arrived at Camp Bowie, in what presently is Cochise County, on October 6th. He traveled at a leisurely pace and did extensive collecting en route. Number 653 is the last bird-skin number from Camp Apache. However, through the number series to the 750's many specimens are labelled "Apache." Other specimens in this block of 100 numbers show progressively greater distance south from Camp Apache until the Gila River was reached on the 10th of September. At least three others on this southbound party occasionally contributed a specimen to the Henshaw series—Magnet or Maquet, McGee, and Turner. They are not listed among the personnel of the expedition and probably were soldiers detailed to the party, or packers.

The party probably followed a route that more or less parallels the present highway from Fort Apache to the San Carlos Reservoir on the Gila River. They reached the river on the 14th of September and crossed it arriving at Camp Goodwin on the flanks of Mount Turnbull on the 17th. There is some confusion about the next fortnight. I suspect that

TABLE V

Field Number	"Gila River"	Camp Goodwin or Mount Turnbull
790	15.ix & 16.ix	
791		
792	16.ix	17.ix (C. G.)
793	16.ix & 17.ix	
794	16.ix & 17.ix	
795	16.ix	
796	16.ix	
797	16.ix	17. "viii" (M. T.)
798	16.ix	
799		17.ix (C. G.) & 19.ix (M. T.)
800		19.ix (M. T.)
"601" [801]		19.ix (C. G.)
802		20.ix (C. G.)

the party may have broken into two groups. There are firm dates and places on bird-skin labels that place members at distances that cannot be traveled in a day on horseback. Also there are duplications of field numbers (Table V).

It appears to me from the second set of duplicate numbers that begin with 890 that some of the "Camp Grant" records should be assigned to "Old Camp Grant" on the San Pedro River, near the present town of Feldman, Arizona. There is no question but the party visited the station now called Fort Grant, in the 1870's "Camp Grant," on the southwest flank of Mount Graham. There is a series of Mount Graham field numbers that immediately precedes the first "Camp Grant" number.

The route from Camp Goodwin and Mount Turnbull to Camp Grant skirted the Santa Teresa Mountains and ran between them and the massif of Mount Graham.

The duplicated field numbers at the end of the 800's are listed in Table VI.

All of this suggests that there was a scattering of Henshaw's party from the time it left the Gila to when it again gathered at Camp Bowie. The "San Pedro" specimens appear to have been collected by Maquet. (See Table VII.)

The single bird-skin from Camp Bowie has a proper locality and date but the field number is out of order.

Camp Bowie, Ariz., to Zuñi, N. M.

From Camp Bowie, Henshaw and his party struck north to the Gila River, via San Simon Valley, and reached the river in the vicinity of the present town of Solomonville. By the 14th of October, they reached

TABLE VI

Field Number	"Camp Grant"	"San Pedro"
890	27.ix	2.x
891	27.ix	2.x
892	28.ix "Bowie"	2.x as "692"
893		.ix (mammal skin)
894	29.ix (2 spec.)	
895	29.ix (2, one "Bowie")	
896	30.ix (2, one "Bowie")	3.x
897	30.ix (2, one "Bowie")	3.x
898	30.ix	3.x
899		1.x & 3.x
900		3.x
901		3.x (2 spec.)
902		3.x
903		("x Apache" a mammal)
904		3.x
905		
906		3.x "Gila R."
907		3.x & 4.x

the mouth of the San Francisco River, a tributary of the Gila. Apparently they camped there a day or so. The route continued to follow the Gila River into New Mexico. They left the Gila at Mangas Creek and via it reached Fort Bayard, New Mexico, on 19th of October. The party stayed at Fort Bayard until the 22nd or 23rd then started for Zuñi. On the 24th they were in Silver City, N. M., and were back on the Gila River on the 25th. It is interesting to note that the specimens collected along the Gila before reaching Fort Bayard all are marked "Gila River, Ariza." and those collected after leaving the fort are marked "Gila River,

TABLE VII

Dates	Field Numbers	Locality
1–4 September	661–699	"nr. Apache"
5–7 September	700–716	"So. of Apache"
8–12 September	717–765	various distances "So. of Apache" and some Gila River labels
14–16 September	766–798*	Gila River
17–19 September	792–800*	Canyons of Mt. Turnbull and Camp Goodwin
20 September	801–802	Camp Goodwin
21 September	803–811	Mount Graham
22–30 September	812–898*	Camp Grant
1–4 October	899–[910?]	"San Pedro"
6–9 October	(933)	Camp Bowie

* overlapping series

TABLE VIII

Dates	Field Numbers*	Locality
14–17 October	911–940	Gila River
19–22 October	946–958	Fort Bayard, N. M.
24 October	959–964	Silver City, N. M.
25 Oct.–4 Nov.	965–978	Gila River, N. M.
5 November	980–993	S. W. of Mogollon Mts.
15 November	979	Tulerosa, N. M.
19–20 November	998–1,008	Salt lakes so. of Zuñi

* The field numbers on this part of the trip are somewhat scrambled. It appears that what collecting was done was held for a few days before the material was logged and ticketed.

N. M." On the 5th of November Henshaw was crossing from the Gila to the San Francisco watershed via Duck Creek southwest of the Mogollon Mountains. Specimens from there are labelled "Mts. nr. Gila R., N. M.," or "Mts. source Gila R.," or "Mts. S.W. N. Mex." From here on the pace was increased and little collecting done. Tulerosa, New Mexico was reached on 15th of November, on the 19th the salt lakes south of Zuñi. Henshaw's last specimens for the season were taken at these lakes on the 19th and 20th of November. Henshaw arrived at Fort Wingate on November 27th and his season was closed for the year.

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KEY TO THE GENERA OF PSAPHIDINI, WITH DESCRIPTIONS OF A NEW GENUS AND SPECIES FROM WESTERN NORTH AMERICA (NOCTUIDAE : CUCULLINAE)

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In analyzing the tribe Psaphidini, the present authors consider the following genera as components: *Psaphida* Walker; *Pseudocopivaleria* Buckett & Bauer, new genus; *Eutolype* Grote; *Copipanolis* Grote; *Copivaleria* Grote; *Brachionycha* Hübner. The tribe is defined by Forbes (1954) and appears to be an unnatural, nonhomogenous grouping when *Feralia* Grote is included. The characters given the greatest consideration herein for tribal distinction are: possession of a corona in the male genitalia; strong foretibial spine, or claw, sometimes attended by a chitinous plate; numerous spines arising from the vesical sac. We exclude *Feralia* from the tribe Psaphidini because members of this genus lack a corona in the male genitalia, the uncus possesses a large double ventral process, and the tibial claw is absent. Even though the general habitus of *Brachionycha* seems atypical for the tribe, it corresponds morphologically, and is therefore included.

While the authors were preparing the description of *anaverta* Buckett and Bauer, new species, it became apparent that this species and *sonoma* McDunnough did not correspond generically with the type species of *Psaphida*. The two western species more closely correspond to *Copivaleria*, but differ by lacking the clasper in the male genitalia, as well as other characteristics to be found in the generic key to the Psaphidini.

Some of the genera within the tribe (e.g. *Copivaleria* Grote, and *Pseudocopivaleria* Buckett & Bauer, new genus) appear to be quite closely related, and perhaps when more species are discovered within these genera, convergence, rather than divergence, will prove to be the pattern. At such time only, will separate generic status be positively established. At present, due to the general habitus of the moths within the tribe, as well as their morphology, it seems best to retain the genera as they are treated by Forbes (1954) and to propose an additional new genus for the two western species, *sonoma* and *anaverta*.

Key to the genera of the tribe Psaphidini

1 Primaries with little pattern, drab, light grey to dark grey; uncus spatulate; female with weakly sclerotized ductus bursae .... *Eutolype* Grote.
Primaries with some pattern, if drab, then not grey; uncus may be thickened, but not spatulate 2

2 Tan to reddish brown or fawn; vesica with one large spine, as well as many smaller ones, the sac somewhat thickened .... *Copipanolis* Grote.
Not of fawn coloration; if vesica possesses a large spine, then sac greatly expanded 3
3 Abdomen with dorsal tufts on segments III and IV; vesical sac only slightly expanded, no conspicuously enlarged spine 4
Abdomen lacking dorsal tufts on segments III and IV; vesical sac greatly expanded, possessing one large spine (as well as many smaller ones) 5
4 Reniform spot of forewing large, whitish; clasper very large, nearly one millimeter long; uncus lanceolate; aedeagus with a heavily sclerotized annulus at apical portion; ductus bursae heavily sclerotized .... *Copivaleria* Grote.
Reniform not as above; clasper lacking; ampulae well developed; uncus tip abruptly pointed, not lanceolate; aedeagus lacking annulus; ductus bursae weakly sclerotized .... *Pseudocopivaleria* Buckett & Bauer, new genus.
5 Uncus thickened; ampulae lacking; greatest expanse of forewing over 20 mm; large, prominent discal lunule of hindwing; ductus bursae heavily sclerotized .... *Brachionycha* Hübner.
Uncus not noticeably thickened; ampulae prominent; greatest expanse of forewing less than 20 mm; discal lunule, when present, weak; ductus bursae weakly sclerotized; bursa copulatrix possessing a signum .... *Psaphida* Walker.

Pseudocopivaleria Buckett and Bauer, new genus

Primaries dark grey with darker markings; secondaries white with dark exterior border in males, to solid fuscous in females.

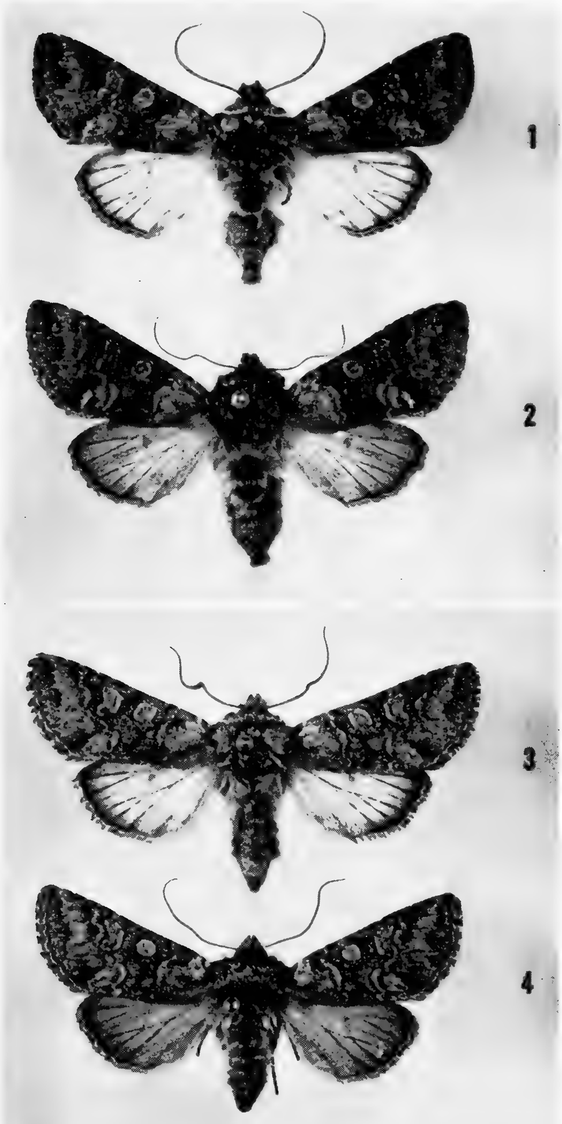
Antennae of male pectinate for greater portion of flagellum, pectinations ciliate, apical few segments moniliform, ciliate; of female, scaled basal portion, ciliate to tip. Head and palpi densely pubescent. Eyes weakly lashed. Proboscis weakly developed. Thorax densely clothed in flattened hairs dorsally; anterior and posterior divided crests present, weak or strong; ventral surface densely pubescent. Foretibiae armed with a heavy terminal claw, no chitinous plate present. Wing shape as in Figs. 1, 2, 3, and 4. Abdomen with dorsal tufts on third and fourth segments; clothed both dorsally and ventrally with thick pubescence. Genitalia of male lacking clasper; aedeagus lacking annulus terminally; ampulae well developed; uncus abruptly pointed; of female, ductus bursae weakly sclerotized.

TYPE SPECIES: *Psaphida sonoma* McDunnough, 1941.

Pseudocopivaleria is most closely related to *Copivaleria* but can be readily distinguished from it by various genital features; in the male by lack of the clasper, whereas *Copivaleria* has a very prominent clasper; absence of apical sclerotized annulus of aedeagus; and abruptly terminated uncus. In the female, the lack of the heavily sclerotized ductus bursae will, in itself, serve to distinguish *Pseudocopivaleria* from *Copivaleria*.

This new genus is exclusively of western distribution, at present being known only from California and Oregon.

Apparently, thus far there has been nothing presented dealing with the immature stages of the species of *Pseudocopivaleria*; however, through personal correspondence with Mr. A. Noel McFarland, a foodplant of *anaverta* Buckett and Bauer, new species, has been reported, canyon oak (*Quercus chrysolepis* Liebmann). Nothing is yet known



1

2

3

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Fig. 1. *Pseudocopivaleria sonoma* (McDunnough), male. Cobb Mt., Lake Co., California, 19 February 1955 (W. R. Bauer & J. S. Buckett). Fig. 2. *P. sonoma*, female. Anderson Springs, Lake Co., Calif., 15 March 1960 (W. R. B. & J. S. B.). Fig. 3 *Pseudocopivaleria anaverta* Buckett and Bauer, holotype male. 2½ miles SSW Valyermo, Los Angeles Co., Calif., 14 April 1964 (Noel McFarland). Fig. 4. *P. anaverta*, allotype female. Locality and collector same as Holotype, 12 April 1964.

concerning the immature stages of *sonoma*, but it is probably an oak feeder also, judging by its close relationship to *anaverta*, both morphologically and ecologically.

Members of this genus inhabit the upper sonoran and transition life zones (after Merriam), and are collected in the spring months.

Key to the species of Pseudocopivaleria

I External morphology

Primaries dark, contrastingly marked; subterminal line at tornus vertical and broad; terminal line composed of black crescents between veins; secondaries narrowly shaded with fuscous, as in (Figs. 1, 2); antennal pectinations short; hair pencil and pocket at base of abdomen .... *sonoma* (McDunnough).

Primaries not as dark, lacking contrasting areas; subterminal line at tornus narrow, diagonal; terminal line continuous, not broken; secondaries broadly shaded with fuscous (Figs. 3, 4); lacking hair pencil and pocket at base of abdomen .... *anaverta* Buckett and Bauer, new species.

II Male genitalia

Ampulae close to base of valva, long and finger-like; uncus blunt; aedeagus as in Fig. 9 .... *sonoma*

Ampulae farther from base, short and triangular; uncus blunt, but more pointed than preceding; aedeagus as in Fig. 10 .... *anaverta*

III Female genitalia

Bursa copulatrix large, median constriction minimal, therefore bursa appears to be broad (Fig. 6) .... *sonoma*

Bursa copulatrix smaller than in preceding, median constriction great, therefore bursa appears to be figure 8 shaped (Fig. 5) .... *anaverta*

McDunnough's description of *sonoma* is very good, and needs little amending, therefore the following description deals mainly with the pertinent points plus supplementary information. At the time of the original description of *sonoma*, the female was unknown.

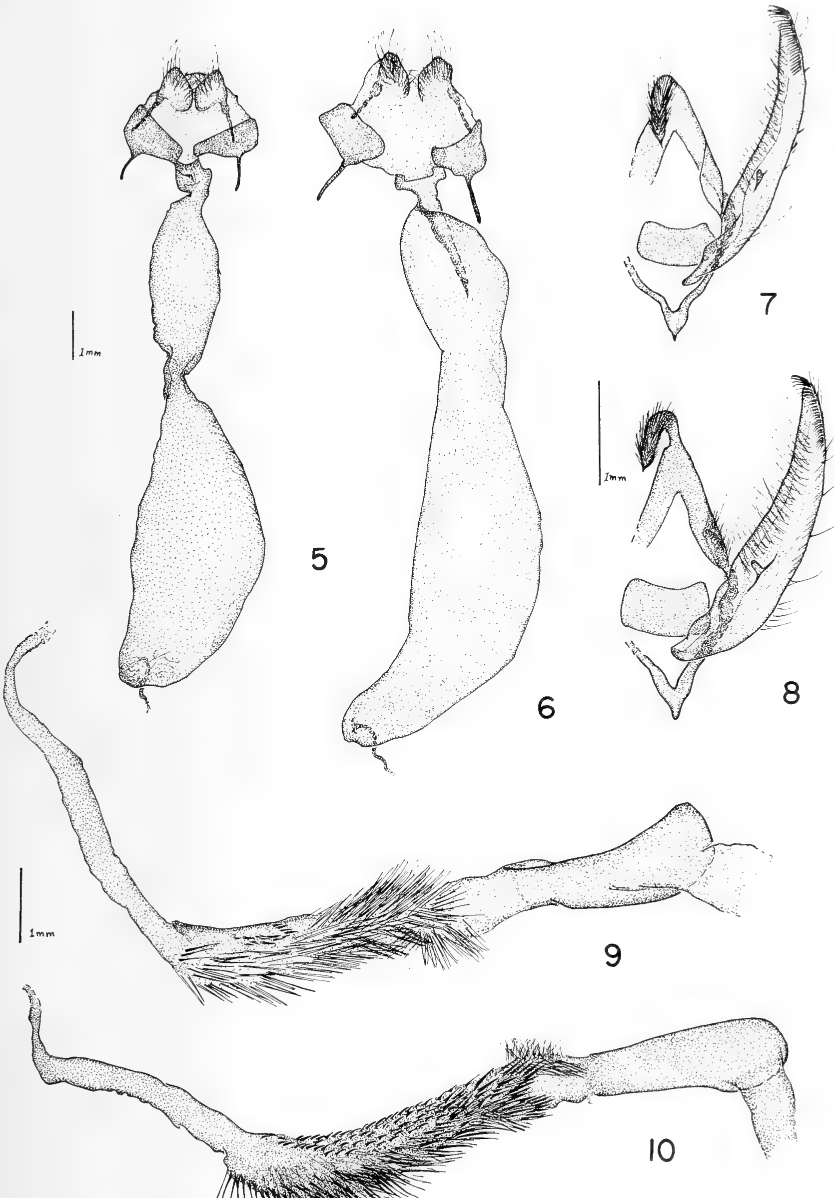
Pseudocopivaleria sonoma (McDunnough)

Psaphida sonoma McDunnough, 1941, Canad. Ent., 73: 67–68.

Male: Head clothed in smokey pubescence with admixture of lighter and darker scaling; antennae pectinate. Thorax with collar porrect, dark, terminally white; tegulae clothed in smokey, white and black spatulate hairs; disc contiguous with tegulae; anterior and posterior divided tufts strong, of black and white spatulate hairs; primaries dorsally with basal half line black; transverse anterior space black, irrorated with white costally, portion of wing toward inner margin with chestnut colored scaling; transverse anterior line geminate, scalloped, black, filled with grey; median space darker than either transverse anterior or subterminal spaces; orbicular

→

Fig. 5. *P. anaverta*, paratype, female genitalia. Data same as Fig. 3 (Bauer & Buckett slide No. 65C26-4). 1 mm measurement to left of figure applicable to Figs. 5 and 6. Fig. 6. *P. sonoma*, female genitalia. Cobb Mt., Lake Co., Calif., 18 March 1955 (W. R. B. & J. S. B.), (B.–B. slide No. 65C26-2). Fig. 7. *P. anaverta*, paratype, male genitalia, aedeagus removed. Data same as Fig. 3 (B.–B. slide No.



65C26-3). Fig. 8. *P. sonoma*, male genitalia, aedeagus removed. Anderson Springs, Lake Co., Calif., 8 March 1959 (W. R. B. & J. S. B.), (B.–B. slide No. 65C26-1). 1 mm measurement to left of figure applicable to Figs. 7 and 8. Fig. 9. *P. sonoma*, aedeagus. Data same as Fig. 8. 1 mm measurement to left of figure applicable to Figs. 9 and 10. Fig. 10. *P. anaverta*, paratype, aedeagus. Data same as Fig. 7.

round, black outlined, centrally paler; reniform pale but darker than orbicular; claviform weak; transverse posterior line colored as transverse anterior line; subterminal area greyish; tornal area with broad streak of creamy white scales (Fig. 1); subterminal line weakly defined; terminal area greyish; terminal line represented by a series of black triangles between veins; ventral surface dark, subterminal line represented by black dash on costa; secondaries dorsally white with thin exterior border of smokey scales; discal lunule faint; veins outlined with smokey; ventral surface similar to dorsal surface; venter of thorax deeply clothed in grey; legs clothed in grey, tarsi black and white banded; foretibiae with prominent anteroterminal spine, or claw. Abdomen smokey with prominent dorsal tufts on third and fourth segments; hair pencil and accompanying pocket present on sternum I; hair pencil composed of clavate sensory hairs which are reticulate for apical one-half (easily discernible under 430×); spiracles with inner lining possessing a row of single, double, or triple pectinate sensillae. Genitalia as in Figs. 8, 9.

Greatest expanse of forewing 16 mm to 18 mm for 29 specimens examined.

Female: Darker than male; antennae ciliate, setose; secondaries dorsally smokey, veins outlined in black, discal lunule faint; ventral surface as in dorsal surface, except discal lunule more prominent; remainder as in male. Genitalia as in Fig. 6.

Greatest expanse of forewing 16 mm to 18 mm for 15 specimens examined.

SPECIMENS EXAMINED. All California unless otherwise stated. Paratype #5184, The Geysers, Sonoma County, 1 ♂, 19 March 1939 (W. R. Bauer); Paratype #5184, Mount St. Helena, Sonoma Co., 1 ♂, 7 March 1940 (W. R. B.); Anderson Springs, Lake Co., 1 ♂, 21 March 1949 (W. R. B.), 2 ♂, 11 March 1955 (W. R. B. & J. S. Buckett), 3 ♂, 3 ♀, 30 March 1956 (W. R. B. & J. S. B.), 1 ♀, 21 February 1958 (W. R. B. & J. S. B.), 4 ♂, 7, 8 March 1959 (W. R. B. & J. S. B.); Cobb Mountain, Lake Co., 8 ♂, 11 March 1955 (W. R. B. & J. S. B.), 2 ♂, 3 ♀, 18 March 1955, 1 ♂, 28 February 1959, 2 ♀, 7 March 1959; Laytonville, Mendocino Co., 2 ♀, 8 May 1949 (R. Sternitsky); 1 mi. N. Elephant Butte, Plumas Co., 1 ♀, 5 April 1960 (W. R. B. & J. S. B.); Placerville, El Dorado Co., 1 ♂, 15 March 1964, 1 ♀, 22 April 1964; Twain Harte, Tuolumne Co., 1 ♂, 29 March 1960 (M. R. Lundgren); Anza, Riverside Co., 2 ♂, 17 April 1965 (R. H. Leuschner); Burney Mountain, Shasta Co., 1 ♀, 25 March 1947; Grants Pass, Josephine Co., Oregon, 2 ♂, 1 ♀, 5 June 1964 (K. Goeden).

P. sonoma can readily be distinguished from *anaverta* as in above diagnosis, by genitalia in both sexes; the possession of a hair pencil and accompanying pocket on abdominal sternum I; the creamy white broad dash in tornus region (Figs. 1, 2). *P. sonoma* is more northern in distribution (see map, Fig. 11) than is *anaverta*.

Pseudocopivaleria anaverta Buckett and Bauer, new species

Holotype male: Head with palpal scaling mixed fuscous and white; frons scaling centrally white with mixed white and fuscous scales around outer edge; vertex scaling mixed white and fuscous, largely fuscous; antennae pectinate. Thorax with collar smokey, possessing two dark, narrow, transverse bands, apically white; thoracic vestiture largely smokey with scales white-tipped; anterior and posterior dorsal tufts prominent; primaries silvery grey, not strongly contrasted; basal area grey, overlain with whitish scales; basal line represented on costa by black dash; basal streak faintly indicated; inner margin from base of wing to transverse anterior area clothed in pale brown scales; transverse anterior line geminate, gradually outwardly oblique, outcurved between veins, inner line faint, centrally filled with whitish scales, outer line black; median area slightly darker than remainder of wing; orbicular nearly round, moderate in size, pale, centrally grey, outlined in black; reniform pale, moderately constricted, centrally filled with grey, outlined in black; claviform small,

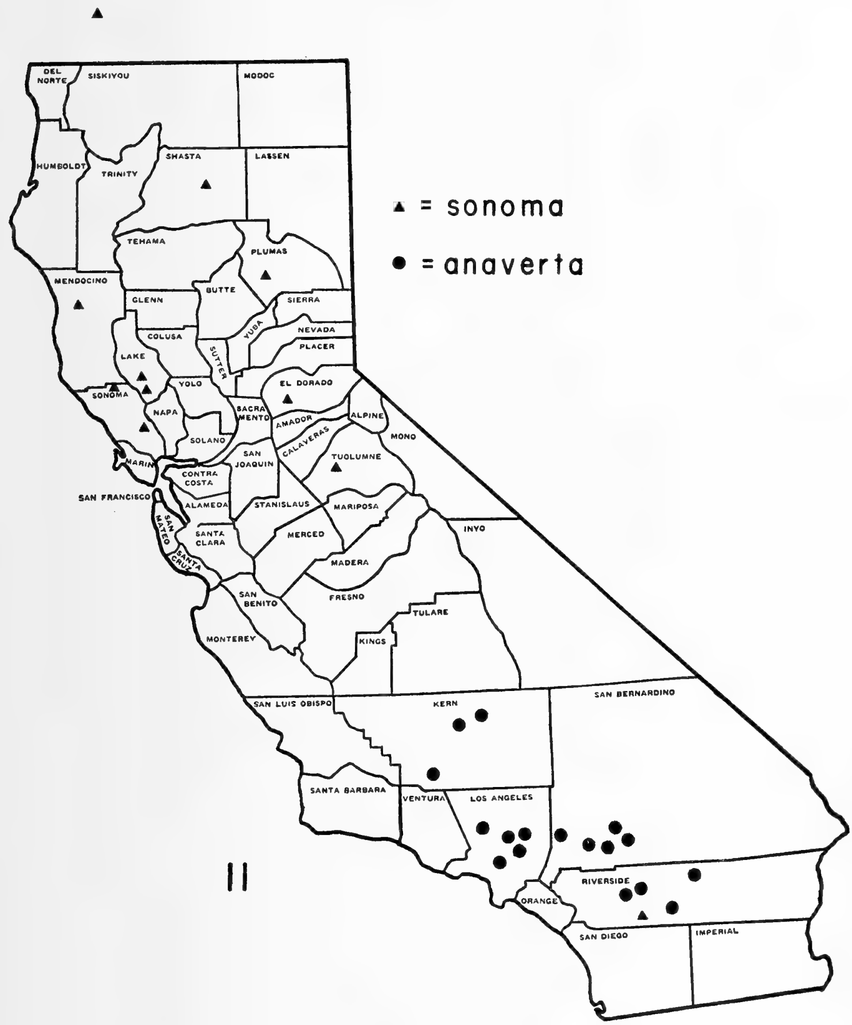


Fig. 11. Distribution of the members of *Pseudocopivaleria*. The triangle to the north of the northern California border represents Grants Pass, Josephine County, Oregon.

pale, outlined in black; transverse posterior line faintly geminate, inner line black, outer line faint, included area pale, irregularly bent closely around reniform, converging with base, thence with a small inward scallop incurved below reniform, followed by a larger scallop inwardly, terminating with a very small scallop to inner margin; subterminal area grey, strongly overlain with white scales, veins somewhat outlined in black; subterminal line irregular, strongest from apex to middle of wing; upper half of terminal area darker grey than subterminal area; tornal area with a black elongate triangle basally from terminal line, projecting inwardly; terminal line continuous, represented by lunules between veins; fringes basally pale, medially

fuscous, terminally checkered; ventral surface mostly deep smokey, basal area pale brown; costal area paler; transverse posterior line represented by dark dash on costa; fringes with dark dots opposite innerspace between veins; secondaries basally white, broadly shaded with fuscous on costa and on outer edge; veins outwardly shaded with fuscous; discal dot faint; postmedial line hardly discernible; terminal area dark; fringes pale, darker shading following; ventral surface whitish, paler than on dorsal surface, with smokey shading costally and along outer margin; discal dot stronger than on dorsal surface; postmedial line represented by dark spots on costa and on inner margin; fringes pale, darker area following; foretibiae possessing strong red–brown terminal claw; each tarsal segment with a white annulus distally; abdomen smokey grey with strong dorsal tufts on segments III and IV. Genitalia as in Figs. 7, 10.

Greatest expanse of forewing 16 mm.

Female: As in male except antennae dentate, and secondaries entirely smokey (see Fig. 4). Genitalia as in Fig. 5.

Greatest expanse of forewing 16 mm.

Holotype male, and allotype, female: California, Los Angeles County, Ranch—2½ mi. SSW of Valyermo (4,800′), 14 April and 12 April 1964, at black light (Noel McFarland). Paratypes: same locality as Holotype, 2 ♂, 20 March 1965 (C. Henne); Singing Springs, San Gabriel Mts., Los Angeles Co., elev. 3,200′, 1 ♂, 1 ♀, 12 April 1948 (C. Henne); 1 ♂, 13 May 1948; 2 ♂, 3 ♀, 28 March 1950 (F. P. Sala); Chilao Flats, Los Angeles Co., elev. 6,000′, 2 ♂, 26 April 1958 (R. H. Leuschner); 4 ♂, 2 ♀, 28 April 1958; Eagle Rock, Los Angeles Co., 1 ♂, 15 April 1950 (F. P. Sala); Buckhorn Flat, San Gabriel Mts., Los Angeles County, elev. 6,400′, 1 ♀, 1 June 1963 (R. H. L.); 1 ♂, 9 May 1959 (C. H.); Hidden Valley, Joshua Tree Natl. Monument, Riverside Co., 1 ♀, 22 March 1948 (C. I. Smith); Idyllwild, Riverside Co., 1 ♂, 1 ♀, 13 April 1960 (J. R. Helfer); Pinyon Flats, San Jacinto Mts., Riverside Co., 1 ♂, 5 March 1960 (R. H. L.); 1 ♀, elev. 4,000′, 2 April 1961 (C. H.); Pinyon Crest, Riverside County, elev. 4,000′, 5 ♂, 6 March 1965 (R. H. L.); 1 ♂, 2 ♀, 21 March 1965; 2 mi. below Greenhorn, Kern Co., elev. 5,000′, 2 ♂, 9 April 1960 (R. H. L.); Mount Pinos, Los Padres Natl. Forest, Kern County, elev. 6,700′, 1 ♀, 10 May 1961 (C. H.); Wrightwood, San Bernardino Co., 4 ♂, 30 April 1964 (C. Hill); 1 ♀, 19 April 1957; 3 ♂, 2 ♀, 12–14 April 1964; Crestline, near Lake Arrowhead, San Bernardino Co., elev. 4,600′, 2 ♂, 1 ♀, 24 April 1965 (R. H. L.); Rimforest, near Lake Arrowhead, San Bernardino Co., elev. 5,600′, 1 ♂, 23 April 1965 (R. H. L.); Barton Flats, San Bernardino Mts., San Bernardino Co., elev. 6,700′, 2 ♂, 1 ♀, 29 April 1959 (C. H.); Cedar Pines Park, San Bernardino Mts., San Bernardino Co., elev. 5,200′, 1 ♀, 3 April 1961 (C. H.).

Holotype male deposited in the United States National Museum, allotype female deposited in the collection of the authors. Paratypes deposited in the following institutions: Bauer-Buckett Collection, Davis; California Academy of Sciences, San Francisco; California State Department of Agriculture, Sacramento; John G. Franclemont Collection, Cornell University, Ithaca, New York; C. Henne Collection, Pearblossom, California; R. Leuschner Collection, Gardena, California; Los Angeles County Museum, Los Angeles; University of California, Davis.

P. anaverta can be readily distinguished from *sonoma* by the less contrasting primaries, lack of hair pencil and accompanying pocket on abdominal sternum I, and other characteristics already mentioned; in general, *anaverta* has a more southerly distribution also (see map, Fig. 11).

We wish to extend our appreciation to those individuals who made available their material for this work. The genitalic illustrations were done by the first author.

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NEW HELIOTHID MOTH FROM THE SOUTHWESTERN UNITED STATES (NOCTUIDAE)

Rowland R. McElvare
Southern Pines, N. C.

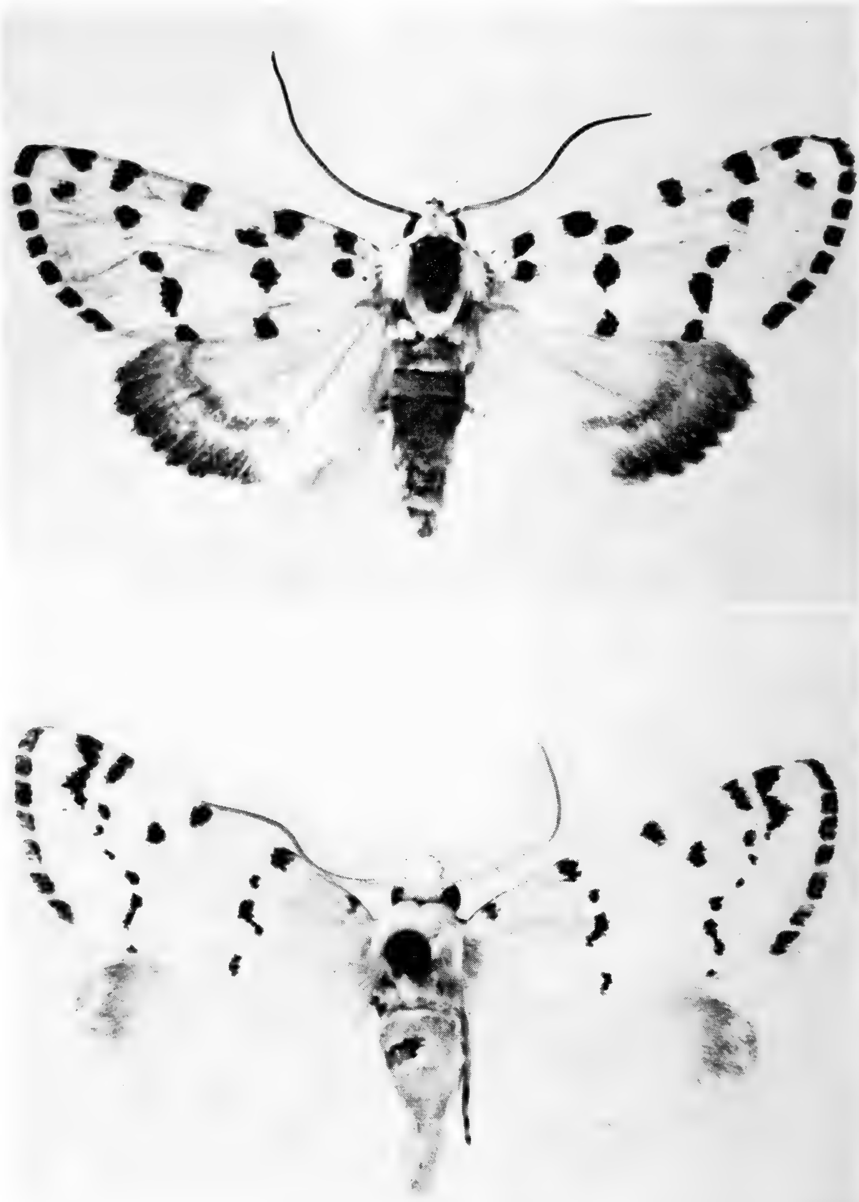
The genus *Grotella* is identified with the southwestern United States, with some records ranging into Colorado. Although adults of a number of species are regularly collected in spring or fall in association with composite flowers in semi-arid areas, the early stages are apparently unknown. Adequate records of time and place of adult flight are available, and some species are common locally. A study of larval forms should not be difficult for lepidopterists in the area and might resolve the problem whether or not the genus properly belongs in the Heliothiinae to which it is currently attributed.

In the Chihuahuan desert in 1948, the Vauries turned up a new *Grotella* (*vauriae* McE.) in the Big Bend National Park, Texas, near Hot Springs on the Mexican border. Mexican lepidopterists' interests seem primarily tropical and American visits to northern Mexico have been sporadic. With roads now more available, this area might well prove a rewarding source of new material.

The following species is described from the same part of Texas and adjacent regions in New Mexico and Mexico.

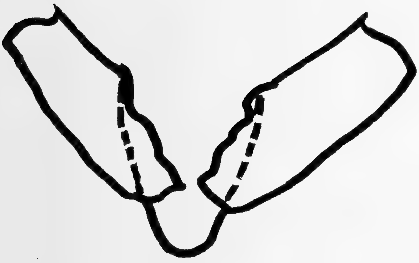
Grotella blanchardi McElvare, new species

Palpi short, porrect, white with dark scaling on terminal segment. Head, thorax, and abdomen, white. Frons with typical *Grotella* hollowed-out process, having corneous walls with a truncate central process, itself slightly hollowed out.



Explanation of plate I

Top: *Grotella blanchardi* McElvare, holotype male, White City, Eddy Co., New Mexico, 9 September 1963 (A. & M. E. Blanchard). Bottom: *Grotella binda* Barnes, male, Redington, Pima Co., Arizona (Barnes Collection).



1

2

Explanation of figures

Figs. 1–2, Vinculum and valvae of male genitalia of *Grotella*, ventral aspect; 1) *G. blanchardi* McElvare; 2) *G. binda* Barnes.

Legs with dark brown banding, particularly on tarsi. Tibiae spinose; on inner side, foretibia with a heavy, terminal spine, curved and pointed, with three or four medium lateral spines above, on outer side, a shorter heavy, terminal spine, with one or two medium lateral spines above; midtibia spined; hind tibia with one or two spines between the pairs of spurs, nearer the lower pair.

Upperside. Primaries white with black spots. A series of five prominent, evenly spaced spots along costa: one near base with a spot below; second one marking transverse anterior line; third spot in medial area; fourth spot marking transverse posterior line; fifth spot marking subterminal line. T.a. line consisting of four spots, approximating a straight line, except spot immediately below costa, angled outward. T.p. line, comprising five spots, slightly bisinuate. S.t. line represented by the spot on costa and one below. Terminal line consisting of seven spots. Fringes white.

Secondaries white with a fuscous border, extending from apex a little more than halfway to anal angle. A similar narrow band inside border. Fringes white.

Underside. Primaries fuscous, the costal margin and apical area white, the three outer costal spots of the upperside are present, together with those of the t.p. and terminal lines. Secondaries white with a faint row of marginal spots, extending halfway to the anal angle, with a narrow crescent above.

The genitalia have the simplicity of the Heliothiinae. The uncus does not have the spoon-shaped tip commonly found in this genus. The tip is cylindrical with a dorsal spine. Vinculum has a rounded base and the vesica has a few small cornuti.

Expanse 24–28 mm.

Holotype, male: New Mexico, White City, Eddy County, Sept. 17, 1963 (A. and M. Blanchard); deposited in U. S. National Museum, Washington, D. C.

Paratypes: 2 ♂, Carlsbad Caverns, N. M., Sept. 17, 1963; 1 ♂, White City, Eddy Co., N. M., Sept. 16, 1963; 3 ♂, west side Grapevine Hill, Big Bend National Park, Texas, Sept. 21, 1963 (A. and M. Blanchard); 2 ♂, Alpine, Texas, and The Basin, Chisos Mts., Texas, Sept., 1958 (McElvare); 1 ♀, Alpine, Texas, July 15–21, 1926 (Poling); 5 ♀ ♀, Big Bend National Park, Texas, Sept. 21, 1963; 1 ♀, White City, Eddy Co., N. M., Sept. 22, 1963 (A. and M. Blanchard); 2 ♀ ♀, La Gloria, S of

Montclova, Coahuila, Mexico, Aug. 24, 1947 (W. Gertsch and M. Cazier).

With the possible exception of the Poling and Mexican specimens, all the above were collected at lights.

Paratypes deposited in the following collections: U. S. National Museum, two ♀♀; the Mexican ♀♀ are in American Museum of Natural History, and 2 ♂♂ in McElvare collection; Blanchard specimens placed in U.S.N.M., A.M.N.H., California Academy of Sciences, Los Angeles County Museum, and McElvare collection; remainder in collection of A. and M. Blanchard, Houston, Texas.

In the type series, the boldness of maculation of the primaries and the bands of the secondaries varies in intensity. The bands are faint in some specimens and lacking in others, particularly the females.

In general appearance, the new species is allied to *Grotella binda* Barnes, which, however, is much smaller (19–23 mm). The maculation of *blanchardi* is bolder and on the primary it has an extra spot below the costal spot nearest the base. It lacks the spot found in the reniform area of *binda*. The secondary of *blanchardi* has two bands, of *binda* an apical patch (Plate I). The armature of the foretibia is more developed, in the new species, particularly in regard to lateral spines, and the tibia of the hindleg is spined. In the genitalia, the marked difference in the harpes is shown in the comparative drawings (Figs. 1, 2). The new species is one of several *Grotella* in which the harpes differ from the generic pattern. Most of the other species are depicted by Barnes and Benjamin (1922).

The distribution of *binda* is Sonoran, southern Arizona, ranging into adjacent areas of New Mexico and southern California. Records thus far available for *blanchardi* are all Chihuahuan, extending from Carlsbad Caverns, N. M., through Alpine and the Big Bend area of Texas to the Montclova region of Coahuila, Mexico. It may be that the difference in boldness of maculation and in size of these allied species in some degree reflects the climatic conditions in their respective desert habitats.

Acknowledgments

Acknowledgment for material made available for study is made to A. and M. Blanchard, Houston, Texas; and Dr. Frederick H. Rindge, Am. Mus. Nat. Hist.; and Dr. E. L. Todd, U. S. National Museum; and to the latter also for providing the photographs of the two species.

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FLIGHT HABITS OF *MORPHO THESEUS JUSTITIAE*

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The collecting season of 1961 found me deep in a mountain region with an environment rather new to me, having collected almost exclusively in the flat or slightly rolling country of the Yucatán peninsula. This, my first extensive mountain collecting, was in the Sierra Chinantla of northern Oaxaca, in southern México, a small but abrupt range running north and south between the Río Cajonos and the Río Santo Domingo and their tributaries, and reaching a maximum elevation of about 3,400 m. So abrupt are the northern slopes that the Tuxtepec–Oaxaca road that cuts through the range climbs 2,900 m. in an upward swing of 60 km. Here in an area where it is very difficult to collect insects, I had the opportunity to observe one of México's most elusive butterflies, *Morpho theseus justitiae*, Salvin & Godman.

It was quite by chance that I ran across this insect, as I had intentions of setting out trap nets for its close relative, *Morpho polyphemus luna* Butlr. I had traveled up the northern slopes of the Sierra in order to reach one of the interior valleys where a collecting group had been stationed two months previously. There, early in the month of September, were dozens of *polyphemus luna* flying everywhere in the almost inaccessible rain forest on both sides of the road, which goes up to about 700 m. elevation; but I could not stop to catch them at the moment as we were planning to transfer the collecting party to the lowlands on the gulf plain after two months of rather unsuccessful collecting in the nearby valley. I immediately made plans to go after the *Morphos* following transfer of the party to a new area. Then I would go alone armed with plenty of bananas for the trap nets which formed part of my collecting equipment. As it was, however, the business of locating a new site on the gulf plain and sampling the local fauna to see if another two months' stay would be worthwhile took longer than I expected, and it was not until the end of September that I returned to the mountains.

With the car bulging with bananas, I eagerly began the trip into the mountains. My destination was a place called Lúumo-Hmíndzáu. It is called Puerto Eligio by the Spanish-speaking people living in the lowlands, and belongs to the municipality of Comaltepec. It is at 700 m. elevation. There were three houses there, one of them unoccupied at the time, which was a vital factor in my choosing the spot. Within one-half kilometer on either approach along the road there were parts of forest

where I could have caught many *polyphemus luna*, and where trap nets could be placed. This spot also happened to be the place where we stationed the car to hike into the valley to the east two months before, some five km. away and about 500 m. below. I was sure I would come away with hundreds of *Morpho* from this spot. Imagine my surprise when arriving there I saw almost none at all where just two weeks previously the area was alive with them.

Even though I was very disappointed on seeing *polyphemus luna* had almost completely disappeared, I decided to stay at the spot to blacklight for nocturnals and see if there was anything else the trap nets would bring in. Almost nothing came to the rotten bananas except some *Euptychia*, but the night collecting with the light became so amazingly productive that I stayed until the end of October.

Another event was even more decisive in my staying on, after the original object of my trip was absent. At the beginning of October, a week of torrential 24-hour-a-day rain began. Night collecting became even better during this week, with plenty of sphingids coming in, as the light was put under one of the house's protruding eaves, and my 350-watt gasoline-driven generator was put inside the house. My greatest surprise came after the rainy spell stopped. On the first sign of the sun peeking through the clouds, I took my net and started down the road by foot to reach one of the areas where *polyphemus luna* had been swarming. I had expected another generation to be on wing after the rain, even though it would have been impossible for so large an insect to have such rapidly succeeding generations. Instead, flying everywhere at certain points along the road was *polyphemus luna's* close relative, *Morpho theseus justitiae*. I was amazed at seeing these, as now I was not presented with the spectacle of great patches of white drifting slowly down from the higher treetops as *polyphemus luna* appears to the observer, but with rich chestnut brown, yellow-tinged jewels gliding about instead. The week of rain must have brought them out. Here, however, was an insect that presented a real problem in collecting. This species has habits so singular that, along with the fact that it is probably very restricted in its range, we can quickly understand why it is so rare in collections of Mexican insects.

Morpho theseus justitiae probably is restricted to the northern, wetter slopes of the mountains in southern México on the gulf side and perhaps some of the other slopes and interior valleys where the mountains are so low as to allow a heavy rainfall to penetrate from the north and east. Where the mountains are high enough, most of the moisture condenses before reaching the summits and, therefore, little rain falls on the south-

ern slopes, consequently creating conditions unfavorable for the species. In the Sierra Chinantla, the valleys are dry to the south where they are connected with the Sierra Juárez, beyond the 3,000-m. pass along the Tuxtepec–Oaxaca road. It is quite probable that the species does not fly anywhere south of this area, nor does it reach the height of the pass on the northern side. I have seen authentic specimens in a collection from Valle Nacional, Oaxaca, 78-m. elevation, at the northern base of the Sierra Chinantla, and have observed living adults from 700- to 1,500-m. and believe that this represents a crosscut of the terrain it occupies. I did not find the insect higher than 1,500 m. F. L. Davis (1928), who spent 30 years collecting in British Honduras, mentions that *theseus justitiae* is found in the Cayo District. As there are no high mountains in the northern part of that district where he did most of his collecting, this is an indication that the species also exists locally where there are lower ranges and where rainfall is sufficient to support the biological environment that the species needs. C. C. Hoffmann (1940) mentions that the species is found in southern Veracruz in the Sierra de San Martín, and at Santecomapan. Thus the insect has a wide range from southern Veracruz and northern Oaxaca through northern Chiapas, El Petén, and into British Honduras, existing in a narrow belt along the northern slopes of the mountains and foothills. In my collection, I have specimens from British Honduras, El Petén, and Oaxaca.

Morpho polyphemus luna frequently flies down from the treetops to almost ground level, and is startled at the slightest movement of people or animals. It prefers to stay in open areas such as along shaded roads, streams, wide trails, or unobstructed parts under a forest canopy, preferring to remain in the shade. *Morpho peliedes montezuma* Guenée is rarely seen flying above treetops, will fly almost anywhere, even in very thick jungles, and tends to follow trails through any kind of thick vegetation. It is the most wary of the three species and quickly dodges into thickets at the slightest sign of people or animals. I have seen individuals fly to one side at seeing dogs or horses coming up the trails the butterflies were using. Just catching a few with a net is no small feat. Perhaps these two species are very wary because their flight patterns allow them to move near the ground and through vegetation, getting themselves into precarious positions among rocks, ravines, trees, etc., thereby making them more vulnerable to attack by predators. *M. theseus justitiae*, however, is a very curious insect. It neither flies near the ground nor startles at any slight movement, at least where I observed it; in fact, a swing with the net may only cause the butterfly to swerve around to investigate the disturbance. The fact that the species does not fly in every place it

could, but instead follows certain flyways and delves in open areas where it may be safe from predators (?), perhaps gives it a lack of concern with anything it may encounter in these areas. Perhaps there is some other reason why it acts so self-confidently and rather unpreoccupied.

As already mentioned, this species is a treetop flier. On level, unbroken terrain, I imagine it would be impossible to collect a good series. The only reason I was able to get close to this species in quantity was the abrupt slopes of the region. The road in mention climbs as it goes south. To the east there is a quick climb where no man or beast can set foot, most of the way. In some places huge overhanging rocks and trees menace the road. On top of this are trees from 20 to 50 m. high in a continuous succession until reaching the summit of a small mountain. In some places, small streams have created gullies where one can climb upwards a bit under gigantic trees, but these places are few. To the west of the road there is a quick drop-off, with some areas dropping off vertically 100–200 m. before slightly leveling off. The downward inclination continues very steep until reaching the river at the bottom of the valley. In some parts where the road has been blasted out of rock, dislodging of rocks and trees below which previously held the runoff resulting from torrential rain, now permits the water to rush down, creating a continuous series of avalanches. From another mountain, one can look back to see the road as it twists precariously around the side of the mountain behind him, observing at the same time the destruction to the forest below the road. Literally the whole side of the mountain below has slid down in some places, carrying trees and everything. Still, there are a number of unaffected parts where the trees almost reach the edge of the road. These places, where there is a continuous series of trees from the valley, and where the tops of those that come closest to the road are at the same level as the road, offer the best places in which to hunt *theseus justitiae*. Individuals coming up the slope about one to two m. above the trees apparently are unable to distinguish some roadside plants from treetops as they come near the road, and this is the place to collect them.

The way in which the butterflies come up the slope is interesting. At first I noticed they would fly close to the edge of the road, circle for about 20 to 30 m., then glide slowly downhill above the trees once more. Later I noticed there were definite hours in which the *justitiae* arrived at the height of the road, the height they would fly at any given time depending on the extent of sunlight on the lower slopes in the morning hours. As this downward slope was on the northwest side of the mountain, it was relatively late in the morning before the tops of the trees

became illuminated by sunlight. This accounts for the late appearance of the species on the northwest side. Whereas on the northeast slope it was on the wing from 9:00 A.M. onwards, on clear days, on the northwest slope where I did my collecting, the species would not fly until the sun was shining on the trees, about 10:00 to 10:30 A.M. Due to the overhanging rocks and formations above the road on the east side, the road and the vegetation along it remained in shadows longer than did the tops of the trees on the downgrade to the west. The species flew above the trees illuminated by the sunlight, flying up from the valley, almost reaching the areas still in shadows, then turning, flying a wide half-circle, and finally gliding downward again. A whole series of *justitiae* would go through this cycle, and one could only guess if they were the same individuals repeating the process after reaching the valley floor. Nevertheless, the parade was continuous. The shadows of the mountain preventing the upward flight of this species established a fact in my mind: that the species is extremely wary of shadows or dark places and does not come within five to six m. of shadows. Even the shadow of a small tree branch will cause them to fly way out of their way.

As the slope became progressivly illuminated by the sun's rays in an ascending direction, the species ventured farther up the slope until arriving close to the area of shadows, only to turn and circle, then drift back down again, always staying in the bright and hot sunlight. The routes on which they ascended and descended changed from hour to hour in the same succession every morning, and I knew I could go to a certain spot at a given hour and find them close to the road. Some of the shrubs and small trees near the edge of the road would throw a shadow into an area that would suddenly be perfectly acceptable to them as soon as the sun rose higher and the position of the shadow changed, whereas previously their continuous parade would circle around through another, shadow-free area. When the sun was high enough, about 11:45 A.M., to illuminate the road and the upward slope on its east side, some of the butterflies would continue flying upward after rapidly crossing at a good height the treeless space afforded by the road, and probably would keep on going until reaching the summit of the mountain, which in this case was only about 900 m. above sea level. Where they went after that is not known, as once they crossed the road and continued upwards, few descended, meaning that the whole area was sufficiently bathed in sunlight so as not to interfere with their course of flight. At about 2:00 P.M. almost all activity ceased, as they suddenly disappeared after that hour. On certain days clouds rolled in from the gulf plain below. Whenever one of these clouds obstructed the sun momentarily, the *justitiae* would

immediately alight on the upper surface of leaves at the top of the highest trees. In no case would they settle on a branch or some of the lower leaves, where they would have to go under something. As soon as the sun came out again, they would continue gliding along their route. Even a slight haze that would not completely blot out the sun would cause them to halt. Full, bright sunlight was a necessity; and this fact, coupled with the necessity to be in an area where one can swing a net above the trees from still higher up, offers the perfect clue on how to catch a series of this species.

At times two males would encounter each other on their flyway and would engage in a short "battle." Sometimes as many as three or four would fly at each other, usually while I was just about to net one of them, with the result that all would fly away. Trying to catch them with a net tied on a pole five m. long was no help. The clumsiness of their flight, not of their gliding, made them poor aggressors; in fact, it made them look as though they were playing. Females were scarce; males made up 99% of the parade. Of the females I saw, all flew above the treetops except one which was winging around under some shrubs obviously looking for a place to oviposit. Probably the females have to fly around above the trees in order to mate, flying at lower levels afterwards where males never venture. Females were readily differentiated from the males when flying by the larger wing expanse and the greater yellowish submarginal maculation on the upperside of the wings.

All in all during 1961, I observed about 500 *justitiae* in 10 days of clear weather at the site. Observations could not be made during the rest of the month due to frequent rains. Even after learning something about the flight habits of this insect, I managed to catch very few. Those I did get were caught with many hours of patience, waiting until an individual came close enough to the road to net. But for every 20 that came close, only one could be caught, even if I was lucky. It was not that the net scared them off, but that the five-m. length of pole weighed about 20 to 25 pounds, and it was only with great difficulty that I could swing it. Taking aim was another matter, as the diameter of my net was only about 42 cm. I was not free to move any way I wished, either, as I had to balance myself on the edge of a cliff where one false step might have meant the appearance of an obituary instead of this article.

In September and October, 1962, I returned to the Sierra Chinantla with two lengths of a very lightweight, hollow, aluminum tubing, each about two m. long, which I could connect, and a net with a diameter of one m. Now that I had something lightweight to catch *theseus justitiae* with, I could get about 10 specimens on a clear day.

This species does not exhibit apprehension of a net nor of a person's movements. When an individual came close but was still out of reach of the net, I would jiggle the handle slightly and the net at the other end would bob around clumsily, actually attracting some individuals, which would immediately swerve around and circle the net to investigate. When I was using my large, lightweight net, I tied a piece of stiff wire to it and bent it so that a dead male specimen tied to the wire would rest above the center of the net. On moving the handle of the net, it would bob a bit and jiggle the dead decoy, making it look as if it were alive and available for "battle" with an oncoming male. This method af attracting other individuals worked to a certain extent, but not as much as I might have liked it to. Many males passed right by, paying no attention to the decoy.

Morpho theseus justitiae never once entered in my trap nets. In 1961 I put 12 trap nets with rotten bananas near their flyway, and surely one of the hundreds which unhurriedly glided by over the trees would have entered if it had any attraction for sweets. It would be interesting to try aerial trap nets that could be suspended from the very highest branches of a tree; however, I doubt the effectiveness of this method. During April, 1965, I managed to catch a worn male in my trap net baited with rotten bananas among some hills near Middlesex, Stann Creek District, British Honduras. Does this seem to disprove my idea that males will not fly under vegetation or do not like sweets? Of the hundreds I saw in Oaxaca, why didn't at least one enter my traps there? For other species, it is a necessity that the trap nets be hung in deepest shade for best results; at least that is my experience.

I do not recommend trying to collect *theseus justitiae* in the Sierra Chinantla of Oaxaca to people with a weak heart or those who become faint on climbing stepladders. For those who may want to try it, the many days of patiently waiting for the rain to stop and for the sun to come out will be well awarded by seeing this species in its natural habitat, an experience that will, at least in the Sierra Chinantla, cause no end to one's marvel at the exotic beauty of deep valleys, huge mountains, and great expanses of primitive rain forest stretching out for kilometers on either side below. Here lives a butterfly that offers a real challenge. To those who try it, good luck!

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LOUISIANA BUTTERFLY RECORDS

BRYANT MATHER
Jackson, Mississippi

As a result of the work of Lambremont (1954), Ross & Lambremont (1963), and Lambremont & Ross (1965), it is possible to examine data on Louisiana butterflies and readily establish whether such data include new parish records or extensions of the known flight period for the state. Data derived from collecting by Mrs. Mather and me in the vicinity of Road's End Camp on April, 3–4, 1965 have been so examined and 12 new parish records and one extension of flight period for the state are here recorded. The data are given below; the names and numbers are as given in dos Passos (1964).

dos Passos No.	Species	Monterey, Concordia Par.	Jonesville, Catahoula Par.
126	*Copaeodes minima* (Edwards)	1 ♂ * (a)	
161a	*Pyrgus c. communis* (Grote)	S (b)*	
236a	*Epargyreus c. clarus* (Cramer)	1 ♀ *	
267b	*Papilio troilus ilioneus* Smith	1 ♀ *	S *
280	*Pieris rapae* (Linnaeus)	S*	
286a	*Colias e. eurytheme* Boisduval	2 ♀ ♀ (c)	
302b	*Phoebis sennae eubule* (Linnaeus)	1 ♂	1 ♀ *
319	*Eurema nicippe* (Cramer)	1 ♀ (d)	
384	*Strymon cecrops* (Fabricius)	2 ♂ ♂, 1 ♀ *	S *
469a	*Everes c. comyntas* (Godart)	1 ♂, 1 ♀ *	
484a	*Anaea a. andria* Scudder	1 ♀	S
556a	*Phyciodes t. tharos* (Drury)	2 ♂ ♂, 2 ♀ ♀	1 ♂
631a	*Danaus p. plexippus* (Linnaeus)	2 ♀ ♀ *	
645b	*Euptychia hermes sosybius* (Fabricius)	7 ♂ ♂, 2 ♀ ♀ *	S

(a) "*" = New parish record.
(b) "S" = Sight record.
(c) One orange ♀, one form ♀ *alba* Strecker.
(d) New earliest date of capture for state, previous earliest date was 8 April 1950 (1 ♀), Lambremont (1954).

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A NEW RACE AND DISCUSSION OF THE *BOLORIA EPITHORE* COMPLEX (NYMPHALIDAE)

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Introduction

On the basis of published records, six species of the genus *Boloria* Moore are known to occur in the state of Washington. They are *B. titania* (Esper), *B. selene* (Denis & Schiff.), *B. astarte* (Doubleday), *B. toddi* (Holland), *B. freija* (Thunberg), and *B. epithore* (Edwards). Of these, only *selene* ssp. and *epithore* have been encountered in Oregon. In California, the only known representative of the *Boloria* complex is *epithore*. In this paper, the authors shall endeavor to examine and discuss the entity known simply as *epithore* for more than a century.

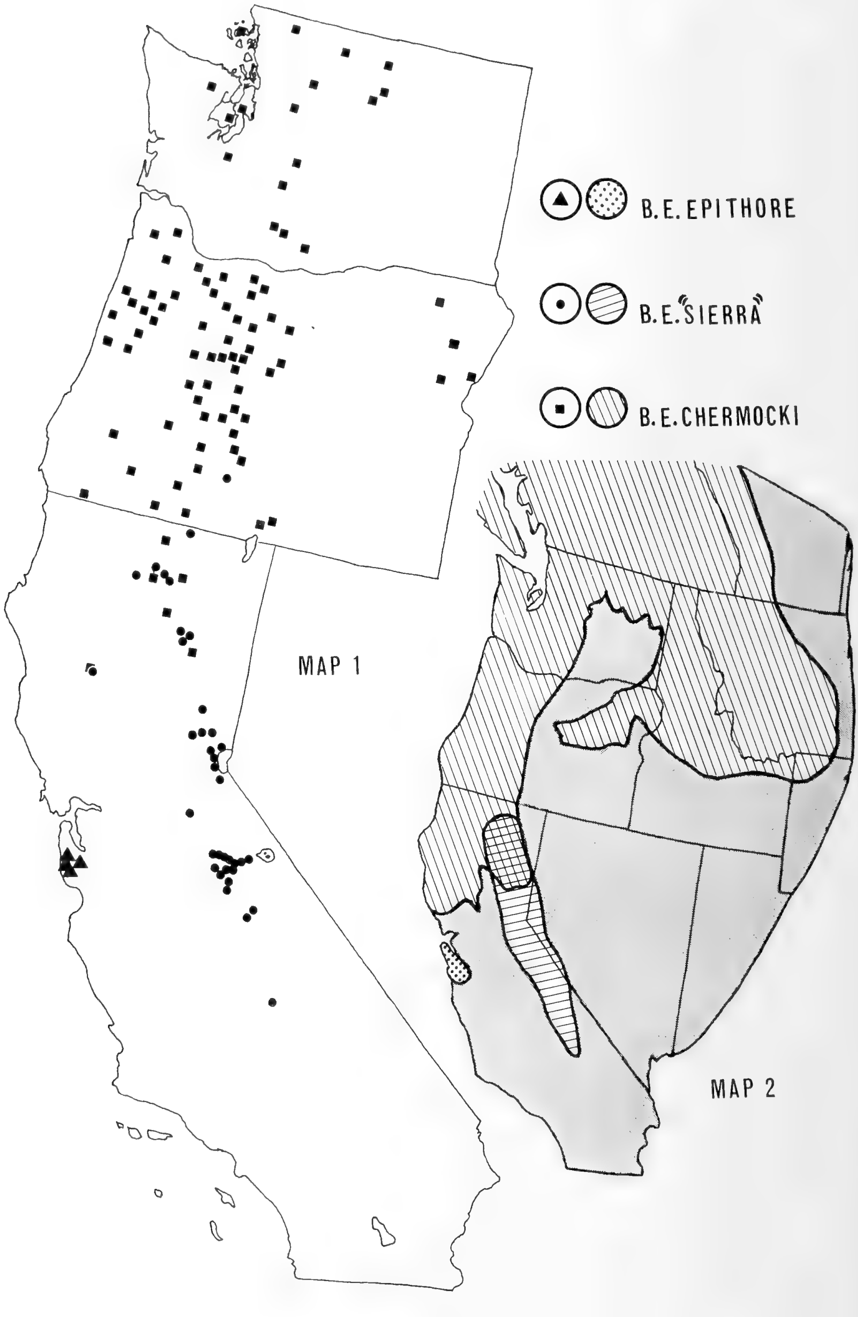
Boloria epithore epithore (Edwards)

Argynnis epithore Edwards, 1864, Proc. Ent. Soc. Phila., 2: 504.

When the nominotypic subspecies, *Boloria epithore epithore* (Figs. 1–4) was described by W. H. Edwards in 1864, California was cited as the type locality; an exact locale was not given. Recently (Brown, 1965: p. 334) a neotype for Edwards' *epithore* was figured and designated, with the data "Saratoga, Santa Clara Co., Calif., R. C. Winslow, May 13, 1899."

There is some question whether Edwards' type specimen was collected in the vicinity of San Francisco. In Volume I of his *Butterflies of North America* ("*Argynnis* VI.") the following statement is made by Edwards regarding "*Argynnis callippe*" Boisduval: "From California. The most common or only species of *Argynnis* found in the vicinity of San Francisco according to Dr. Behr. . . ." Volume I was divided into 10 parts; each part had a different date of issuance. Part two of Volume I, which contained "*Argynnis callippe*," was issued in August, 1868. This is four years after Edwards' description of *epithore* was published. Surely, if Edwards' type specimen of *epithore*, from Behr's collection (Brown, 1965: p. 337), had been collected in the vicinity of San Francisco, Behr would not have made such a misleading statement. This would lend support to the theory that Edwards' *epithore* was collected in the Santa Cruz Mountains, approximately 40 miles SSE of San Francisco.

The known range of typical *epithore* extends from southern San Mateo County south through the Santa Cruz Mountains of Santa Cruz and Santa Clara counties (Map 1). R. L. Langston (*in litt.*), of Berkeley,


B.E. EPITHORE
B.E. "SIERRA"
B.E. CHERMOCKI
MAP 1
MAP 2

California, and O. E. Sette (*in litt.*) of Los Altos, California, state that they have never encountered *epithore* north or south of these limits. However, in 1910, Williams (Ent. News, 31: 30) stated that *epithore* had been collected "a good many years ago" in Golden Gate Park, San Francisco. Thus, there is reason to believe that the species did range northward prior to the concentrated urbanization of the San Francisco peninsula. Throughout its limited range, colonies of *epithore* are local and not easily discovered.

The authors have examined a series of 23 males and nine females from the following locales:

SANTA CRUZ CO.: Vicinity Boulder Creek, Big Basin, 1200 feet.
SAN MATEO CO.: San Lorenzo Woods, 600 feet.

Statistical data pertinent to typical *epithore* is outlined in Table 1.

In describing the superficies of *epithore*, Edwards' original description will be utilized:

"*Argynnis epithore*, Boisduval *in litt.* . . . Male. Expands 1$\frac{5}{10}$ inch. Primaries rounded as in Myrina, not angular at apex and excavated on the margin, as in Bellona, to which last it is most closely allied. Upper side pale fulvous at the base; hind margins bordered by a slight, interrupted line, with small lunules; otherwise the usual markings. Under side of primaries fulvous, yellowish at apex, with ferruginous sub-apical patch. Secondaries have an angular submesial band of irregular spots, as in Bellona, each whitish, sprinkled in the centre with ferruginous, in the cell a round black spot; beyond the band to the margin a slight violet tinge, with a submarginal series of round spots and marginal lunules."

Although somewhat cursorily treated, the foregoing description is applicable to those *epithore* which occur in the Santa Cruz Mountains. There are, however, two discrepancies. Edwards indicated that the submedian–median band of the ventral secondaries contains "spots, as in Bellona, each whitish, sprinkled in the centre with ferruginous . . ." Of the 32 examples examined by the authors from the Santa Cruz Mountains, only one, weathered female displays "whitish" spots. However, even these spots have a noticeably yellowish hue; the remainder of the series have yellowish cream spots. Perhaps Edwards' connotation—"whitish"—was intended to imply an off-white color. Secondly, Edwards' explicit comment regarding the "pale fulvous" color of the dorsal, basal regions is not consistent with the 32 examples used in this study,

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EXPLANATION OF MAPS

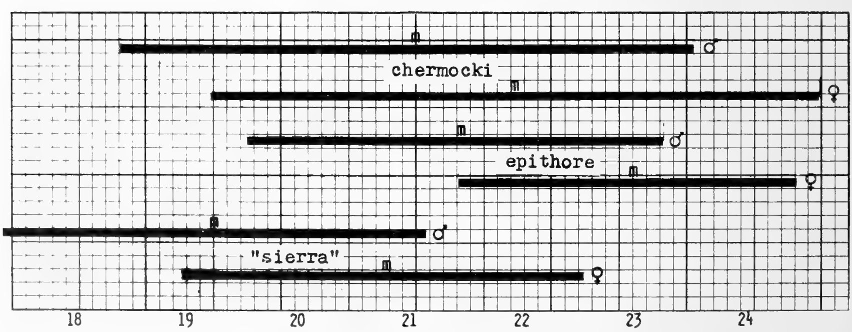
Map 1: Distribution of *Boloria epithore* complex in the Pacific Coast states. Each symbol corresponds to one or more specimens used in this study.

Map 2: Projected distribution of *Boloria epithore* complex in western North America based upon records and specimens of the authors.

TABLE 1

	CHERMOCKI		EPITHORE		"SIERRA"	
	male	female	male	female	male	female
N	72	66	23	9	57	27
99% limits	21.10+2.53	22.01+2.74	21.50+1.78	23.00+1.39	19.30+1.91	20.79+1.80
Mean (mm)	21.10	22.01	21.50	23.00	19.30	20.79
P.e.m. (mm)	0.08	0.09	0.10	0.19	0.08	0.13
S.D. (mm)	0.98	1.06	0.69	0.54	0.74	0.70
v	24.22	27.95	11.76	7.38	13.50	12.23
σ	4.919	5.283	3.429	2.717	3.674	3.507
"t score" compared to:						
CHERMOCKI	-----	-----	2.86	4.50	18.00	7.18
EPITHORE	2.86	4.50	-----	-----	15.71	9.21
"SIERRA"	18.00	7.18	15.71	9.21	-----	-----

TABLE 2



99% limits of LFW (mm) (m = mean of respective sexes)

since all were found to have black or fuscous dusting on the hindwings dorsally (usually extending outwardly as far as the postbasal region); the forewings dorsally have only slight black, basal dusting. Thus, these specimens are certainly not "pale fulvous at the base." The male specimen used by Edwards in describing *epithore* may have been an extreme example, which was generally very light in coloration. In size, Edwards'

type (which measured "1$\frac{5}{10}$ inch" in expanse, or approximately 38 mm) is slightly smaller than the average size of those Santa Cruz County specimens examined.

The recently designated neotype of *epithore* has a left forewing (LFW) measurement of 24 mm (Brown, *in litt.*). This expanse is somewhat larger (Table 2) than that average measurement derived by the authors, although a difference in locality and altitude may account for this variation.

Boisduval's use of the name epithore

The introduction of the name *epithore* cannot be attributed to Edwards, although he was the first to publish it. In his original description, Edwards states: "This species, as I am informed by Dr. Behr, is undescribed and only named in letters of Dr. Boisduval." The original description in which Boisduval used the name *epithore* appeared in 1869 (Ann. Soc. Ent. Belg., 12: 58; no. 50).

In an attempt to determine the locality from which Boisduval's type of *epithore* was collected, the authors have encountered certain contradictory information.

The lectotype of Boisduval's *epithore* (figured by Brown, 1965: p. 335) is in the collection of the Carnegie Museum. Its superficial appearance is analogous to female *epithore* from the Santa Cruz Mountains. The large size—25.0 mm LFW (Brown, *in litt.*)—is characteristic of typical *epithore*; however, the greatest LFW measurement made by the authors on female *epithore* from Santa Cruz County was only 24.0 mm. Table 2 indicates that the LFW radius of the lectotype of Boisduval's *epithore* exceeds the "99% Limits" (Brown, 1951) of the series used in this study.

The specimen figured by Brown as the " 'Type' of *Argynnis epithore* Boisduval" has an unconnected median row of black spots on the dorsal secondaries. On the primaries these spots tend to be slightly fused or connected by transverse black scales along the veins. This characteristic is common only to nominotypic *epithore*. Conversely, the lack of connected spots is sometimes evident in Plumas County material. In addition, the specimens from this latter region are not as large as those which occur in the Santa Cruz Mountains. The greatest LFW measurement of female *epithore* from Plumas County was 22.5 mm. Furthermore, Boisduval refers to the submedian–median area of the ventral secondaries as being "jaune saupoudrée de brun" (brown-powdered yellow). This coloration is not only visible on *epithore* from the Santa Cruz Mountains, but also on specimens from populations inhabiting Plumas County. In his original description, Boisduval states: "M. Lorquin a trouvé cette

espèce dans les hautes montagnes de l'est oú elle est fort rare et difficile à prendre" (Mr. Lorquin found this species in the high mountains of the east where it is extremely rare and difficult to capture). Although it would seem that he clearly indicated that the material he had examined did come from an area or areas in the mountains of eastern California, a statement in Volume 3 of Edwards' *Butterflies of North America* strongly indicates that Boisduval's locality statement may be misleading.

From "*Argynnis* VIII."—"*Argynnis adiante*" Boisduval, Edwards states: "The male figured on our Plate is the original type of Dr. Boisduval, sent me by himself, and bearing his label as 'type *adiante*'." Edwards then quotes Boisduval as saying: "This beautiful *Argynnis* was taken in some numbers by M. Lorquin, on the edges of the woods, in the eastern part of California." Edwards continues: "Of late years *adiante* has not been a very common species in collections, owing to its local habits, apparently. Professor J. J. Rivers writes me that 'it is found above Los Gatos in the Santa Cruz Mountains. It also occurs at several localities in the same range, and in Santa Clara and San Mateo counties; but it does not appear to be found farther south than about nine miles north of Santa Cruz city.' Apparently Dr. Boisduval was mistaken in the locality." Boisduval described *adiante* (now a synonym of *Speyeria egleis adiaste* (Edwards)) on page 61 of the same publication which contained his original description of *epithore*. Both the *adiante* and *epithore* types used by Boisduval in his original descriptions were collected by Lorquin. In both original descriptions, Boisduval referred to eastern California and the high mountains of the east as the localities from which the respective types were collected. However, dos Passos & Grey (1947) fixed the type locality for *adiante* as the "Santa Cruz Mountains, California." The type locality for Edwards' *adiaste* is also in the vicinity of the Santa Cruz Mountains.

In view of the above information, it becomes apparent that Boisduval's type of *epithore* most probably was collected in the vicinity of the Santa Cruz Mountains and not somewhere in "the high mountains of the east."

Because Boisduval's original description of *epithore* appeared five years after Edwards' use of the name, Edwards' *epithore* takes priority.

ELDORADO Strand

Brenthis epithore Boisd., cum. ab. *eldorado* Strand, 1914, Archiv für Naturgeschichte, 80(A) pt. 11: 156.

Embrik Strand described *eldorado* on the basis of six examples from Plumas County, collected from June 10 to June 17, 1913, and one speci-

men from El Dorado County, collected between June 25 and June 28, 1913.

The distinguishing features indicated by Strand in his description are: (1) the black markings on the underside of the forewings are large and consequently appear to be near to one another; (2) the two transverse spots in the middle of the field (in cells M_3 and CU_1) are connected by means of a median, black longitudinal line; (3) the angled figure in the cells (discal cell) completely or almost completely touches the discocellular spots; and (4) the three or four postmedian spots touch or almost touch the transverse lines in the form of black flecks. Strand also mentions that the black design above is stronger in both wings.

From this information and a study of material from both Plumas and El Dorado counties, the authors conclude that Strand's name, *eldorado*, represents an aberration. However, the degree of divergence from the normal form does not appear to be extensive. Under the rules of the International Code of Zoological Nomenclature, *eldorado* must be regarded as being of infrasubspecific rank.

WAWONAE Gunder

Brenthis epithore Bdv., ab. *wawonae* Gunder, 1924, Ent. News, 35(5): 156.

The type of *wawonae* was collected at Wawona (in Yosemite National Park), Mariposa County, California on July 6, 1922 and is pictured in J. A. Comstock's *Butterflies of California*, Pl. 26, fig. 10. The distinctive feature of *wawonae* is found on the secondaries where the row of postmedian spots is "lacking."

As is *eldorado*, *wawonae* is now considered an infrasubspecific entity.

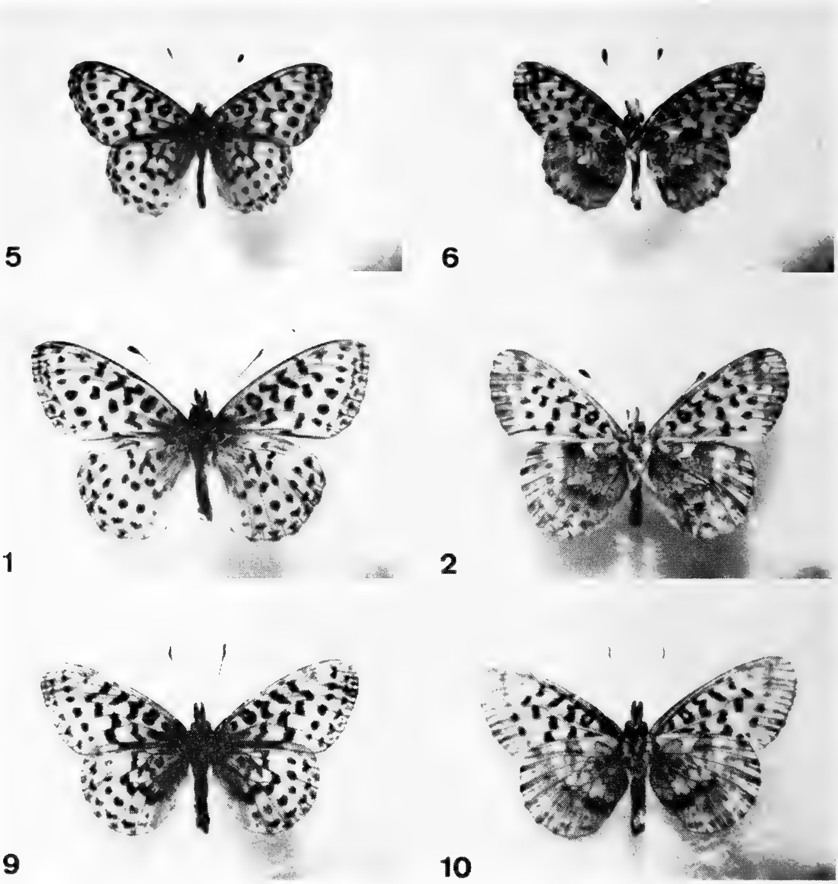
OBSCURIPENNIS Gunder

Brenthis epithore Bdv., ab. *obscuripennis* Gunder, 1926, Ent. News, 37(1): 7.

The type of this aberration, a female, was collected at Chilcolin, British Columbia, Canada, on May 30, 1915. In the original description Gunder states: "Primaries entirely fogged over with dark shading, obscuring and submerging maculation, especially on the inner half with cell quite dense where only a single yellow brown spot shows; normal row of round black spots indistinctly visible. Secondaries, outer half normal; confused yellow brown maculation of inner half externally edged by black shading which extends also along the costal margin, basal area quite dark." The above quotation applies to the dorsal surfaces. Because it is a melanic aberration, and since it was originally described as such, *obscuripennis* must also be considered infrasubspecific.

Boloria epithore chermocki Perkins and Perkins, new subspecies

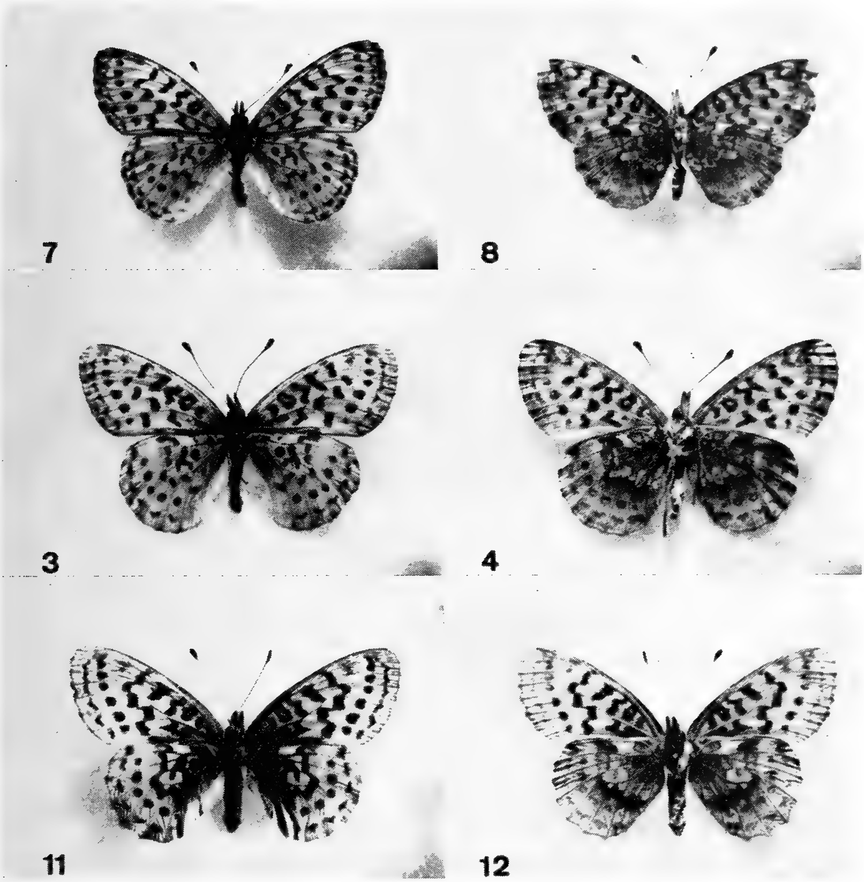
Males: Dorsal LFW (Expanse: 21.10 ± 2.53 mm), holotype 21.40 mm.



EXPLANATION OF PLATE I

Adult males of *Boloria epithore* complex: 5) "sierra," Donner Summit near Truckee, Placer Co., Calif., 3-VIII-60 (T. C. Emmel); 6) "sierra," Yosemite National Park, Mariposa Co., Calif., 3-VII-62 (E. M. Perkins, Jr.); 1) *epithore*, Big Basin, Santa Cruz Mts., Santa Cruz Co., Calif., 4-V-46 (O. E. Sette); 2) *epithore*, Big Basin, Santa Cruz Mts., Santa Cruz Co., Calif., 4-V-46 (O. E. Sette); 9) *chermocki* (holotype), 2.9 miles E Dolph, Yamhill Co., Oregon, 18-VI-62 (S. F. Perkins); 10) same, ventral aspect. Figures to the left are dorsal; those to the right are ventral.

Females: Dorsal LFW (Expanse: 22.01 ± 2.74 mm), allotype 23.00 mm. *Male*: Upper surface: Black spots within median band on both primaries and secondaries tending to be fused or connected, giving effect of a continuous, irregular black line; on typical *epithore*, these spots only slightly connected on primaries, on secondaries without connecting scales. Black basal suffusion heavily represented, often extending outwardly as far as submedian area; on *epithore*, black suffusion seldom extending beyond postbasal region. Segment of vein RS on secondaries bordering cell



EXPLANATION OF PLATE II

Adult females of *Boloria epithore* complex: 7) "sierra," Greenhorn Mts., Kern Co., Calif., 24-VI-61 (R. E. Stanford); 8) "sierra," below Huntington Lake dam, Fresno Co., Calif., 9-VII-60 (O. E. Sette); 3) *epithore*, Big Basin, Santa Cruz Mts., Santa Cruz Co., Calif., 6-VI-45 (O. E. Sette); 4) *epithore*, Big Basin, Santa Cruz Mts., Santa Cruz Co., Calif., 10-VI-45 (O. E. Sette); 11) *chermocki* (allotype), 2.9 miles E Dolph, Yamhill Co., Oregon, 18-VI-62 (E. M. Perkins, Jr.); 12) same, ventral aspect. Figures to the left are dorsal; those to the right are ventral.

noticeably accentuated by black scales connecting this segment to angled figure in cell; rarely an indication of this on *epithore*.

Undersurface: On secondaries, submedian–median row of spots chrome-yellow, this region in *epithore* cream to yellow with noticeably heavy, ferruginous dusting. Postbasal area of secondaries, below denticulate white spot bordering vein RS (infrequently invaded by yellow scales) yellow-brown to orange-brown (latter more common), in this respect, basal and postbasal areas analogous; these areas on *epithore* red-brown. Postmedian band of secondaries purplish to lilac inwardly, con-

trasting to the lighter, outward limits of this band; this contrast much less evident on *epithore*.

Female similar in appearance to male.

Holotype, male and allotype, female: 2.9 miles E of Dolph, Yamhill Co., Oregon, 18 June 62 (S. F. Perkins and E. M. Perkins, Jr.); placed in the collection of the Los Angeles County Museum, Los Angeles, California. Paratypes (48): Oregon, Yamhill Co.: 0.5 to 2.9 miles E of Dolph, 10-VI-62, 18-VI-62, 12-VI-63, and 27-V-65, 29 ♂♂, 19 ♀♀ (Perkins'); 6 ♂♂ and 4 ♀♀ have been deposited in each of the following institutions: The California Academy of Sciences, San Francisco, California and The American Museum of Natural History, New York City, New York; 9 ♂♂ and 6 ♀♀ will be deposited with the holotype and allotype; 8 ♂♂ and 5 ♀♀ have been retained by the authors.

This new subspecies is named in honor of Franklin H. Chermock, Baltimore, Maryland.

The authors have examined and/or have records for more than 300 representative examples of *chermocki* (Figs. 9–12) from the following localities in Oregon (Map 1):

BENTON CO.: Alsea; McDonald Forest near Corvallis; Mary's Peak; Hoskins. CLACKAMAS CO.: Clackamas Lake; along Clackamas River Road; 6 miles W Lake Timothy; Austin Hot Springs; Big Eddy; vicinity Mt. Hood. CLATSOP CO.: Saddle Mountain State Park. COLUMBIA CO.: Vernonia. DESCHUTES CO.: Deschutes River Bridge (W Terrebonne). DOUGLAS CO.: Bradley Creek Meadows; junction of Muir Creek–Rogue River; Diamond Lake. HOOD RIVER CO.: Cloud Cap Road to Mt. Hood. JACKSON CO.: Kane Creek (5 miles W Gold Hill); Mt. Ashland; French Gulch road; Tubb Springs (4 miles W Pinehurst). JEFFERSON CO.: Santiam Pass; Camp Sherman. JOSEPHINE CO.: near O'Brien. KLAMATH CO.: Davis Lake; Crater Lake National Park; Crescent Creek at highway 58; Skookum Meadows; 5–10 miles E Beaver Marsh; Sand Flat (S of Skookum Butte); Gilchrist. LAKE CO.: Summit Prairie (SE Warner Canyon); Lakeview. LANE CO.: Mule Prairie (N Willamette Pass); Oakridge; Hills Creek Dam road; Blue Pond Forest Camp; Willamette Pass. LINCOLN CO.: Elk City. LINN CO.: Cascadia; Monument Peak; Front Creek Camp (S Santiam highway); Tombstone Prairie; Lost Prairie; Marion Mountain; Big Meadows; Santiam Pass. MARION CO.: Elk Lake. POLK CO.: Valsetz; Falls City. TILLAMOOK CO.: Lee's Camp (Highway 6). UMATILLA CO.: NE Tollgate (Blue Mountains). WALLOWA CO.: Lostine River. WASCO CO.: Wapanitia; Bear Springs Campground. YAMHILL CO.: Baker Creek Valley and vicinity of Dolph.

Throughout its range, including Washington, southern British Columbia, southern Alberta, Idaho, Montana, and extreme north central California (refer to Map 2), *chermocki* remains constant in superficial appearance.

A DWARFED SIERRA NEVADA FORM—"SIERRA"

There remains one *epithore* entity which is pertinent enough to a complete discussion of the species complex to warrant inclusion in this paper.

A dwarfed form of *epithore* (Figs. 5–8) occurs along the length of the Sierra Nevada of California. The authors have examined nearly 100 specimens from 12 localities, ranging from Shasta County in the north to Kern County in the south. The localities from which these specimens were collected (Map 1) are as follows:

AMADOR Co.: 27 miles ENE Jackson. EL DORADO Co.: McKinney Creek, 3 miles SW Tahoma P.O., Lake Tahoe; Tahoma P.O., Lake Tahoe. FRESNO Co.: below Huntington Lake Dam; Round Meadow, Huntington Lake. KERN Co.: Tiger Flat Campground, Greenhorn Mountains. MARIPOSA Co.: Highway 120, Yosemite National Park. PLACER Co.: Deer Park Ski Area, 2 miles W Lake Tahoe; Donner Summit, near Truckee; Yuba Gap, W Donner Summit. SHASTA Co.: near Bigelow, 16 miles SE Mt. Shasta; 15 miles SW Mt. Shasta; 26 miles SE Mt. Shasta. SIERRA Co.: near Gold Lake Lodge. TEHAMA Co.: Mill Creek, 8 miles SW Mt. Lassen.

Populations of the typical dwarfed form occur neither north of Sierra County nor south of Kern County (Map 2). Within this range, its size (the outstanding characteristic) remains constant.

Statistical analysis (following Brown, 1951) of 254 *epithore* specimens (typical *epithore*, northwestern *chermocki*, and the dwarfed mountain form which will hereafter be referred to in this paper as "sierra"), listed in Tables 1 and 2, indicates that although *chermocki* is slightly larger than *epithore*,[1] both are markedly larger than the diminutive "sierra."

A careful examination of all specimens relative to this study indicates that the majority of specimens from "sierra" populations evince yellowish-colored spots in the submedian–median bands (ventral secondaries) over which ferruginous scales are scattered. These scales are often so heavily aggregated that they completely mask the ground color of these bands. Specimens exhibiting a cream-colored row of submedian–median spots also exist within "sierra" populations. However, gradation is evident from one extreme (cream) to the other (yellow).

In 1961, Ray Stanford of Los Angeles, California discovered a population of "sierra" while collecting in the vicinity of Tobias Peak, located in the Greenhorn Mountains south of the Tulare–Kern county line. Several examples from this population display a golden-yellow, dorsal ground color. This phenomenon also exists to minimal varying degrees in typical *epithore* and *chermocki* populations.

It is debatable whether Stanford's Kern County capture represents the southernmost record for *epithore*. For instance, Lloyd M. Martin (*in litt.*) indicates one earlier record ("early 1930's") from the Greenhorn Mountains of Kern County. The material was collected by Monroe Walton, of Glendale, California. However, both the deposition of the

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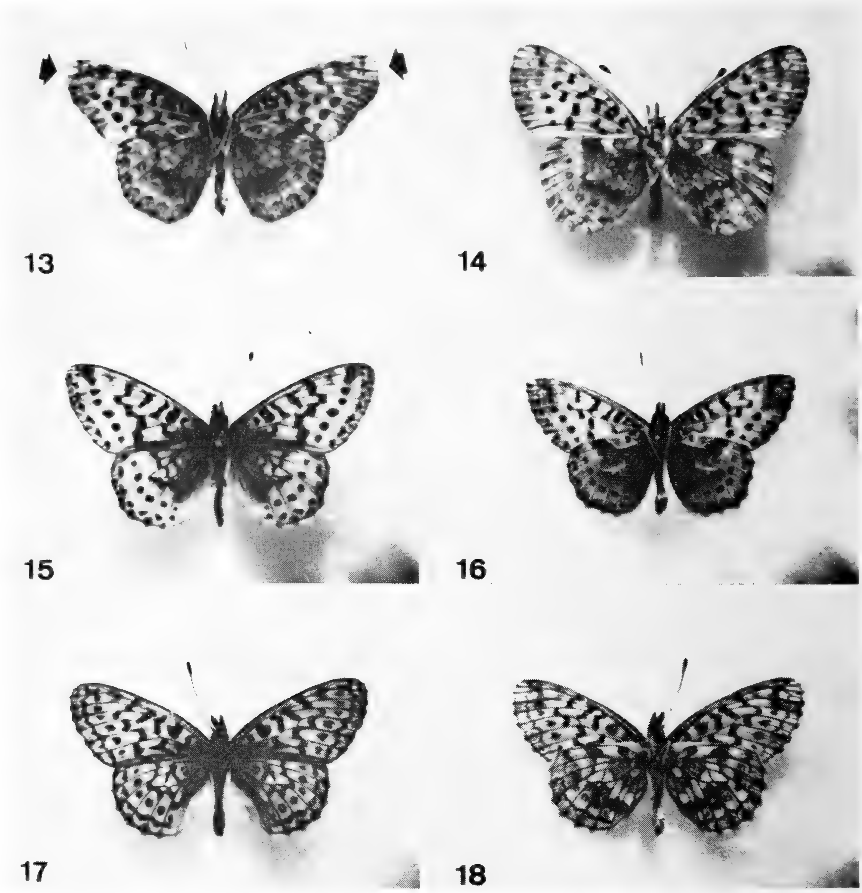
[1] Based on the "99% Limits" comparison in Table 2. According to the mean comparisons in Table 1, however, *epithore* surpasses *chermocki* in size.


13 14 15 16 17 18

EXPLANATION OF PLATE III

Comparison of four species of *Boloria*: 13) *toddi ammiralis* Hemming, male, ventral, Baltimore, Baltimore Co., Md., 11-V-63 (F. H. Chermock); 14) *epithore epithore* Edwards, male, ventral, Big Basin, Santa Cruz Mts., Santa Cruz Co., Calif., 4-V-46 (O. E. Sette); 15) *frigga sagata* Barnes & Benjamin, male, dorsal, Caribou Bog, Boulder Co., Colorado, 23-VI-64 (J. A. Justice); 16) *frigga sagata*, male, ventral, Caribou Bog, Boulder Co., Colorado, 23-VI-64 (J. A. Justice); 17) *kriemheld* Strecker, male, dorsal, 4 miles W Teton Pass, Teton Co., Wyoming, 17-VII-63 (E. M. Perkins, Jr.); 18) same, ventral aspect.

material and the precise locality of capture are unknown. Wright (1906, plate XVII, fig. 152) figured a lesser fritillary from the ". . . San Francisco Mts., Arizona, 1887; F. Stephens . . ." which he identified as *Boloria kriemheld* (Strecker) (1879)." However, Wright's locality information and classification are somewhat questionable. Kilian Roever (*in litt.*) and R. F. Sternitzky (*in litt.*) indicate that they have never encoun-

tered species of the genus *Boloria* in Arizona. In appearance, the specimen figured by Wright more closely resembles *epithore* than *kriemheld*. However, in his original description of *kriemheld*, Strecker indicated that he not only had specimens from Colorado, but also Arizona. F. M. Brown (*in litt.*) states: "The types were taken in September on the Rio Florida (east of Durango) in southwestern Colorado by Lt. MacCauley. I have seen them and they are so labeled." The authors have examined examples of *kriemheld* from the Uintah Mountains of Summit County, Utah. These specimens are definitely *kriemheld*, not *epithore*, with which they have often been confused. Extensive series from western Wyoming have also been examined; the name *kriemheld* applies to these as well. A comparative discussion of these entities will follow later in this paper.

Assuming conducive criteria to be present (both climatic and ecological), species of *Boloria* (perhaps *kriemheld* since Arizona was included in its original description), might exist in the San Francisco Peaks of Coconino County. Roever (*in litt.*) states: "Although surface water is generally nonexistent in that area, there is one wet meadow at about 9,000′. There are also a number of likely spots for *Boloria* in the White Mountains which I have checked without success."

Coincident to this study, the authors considered the possibility that "sierra" might represent an unnamed subspecies. However, since the only constant, major distinction between it and typical *epithore* is size, there seems little justification in assigning a name to it.

Clinal tendencies of the dwarfed "sierra" are evident in Sierra County. Northward, in Plumas County, the specimens become larger and possess submedian–median rows of yellow spots on the hindwings ventrally which, although similar to those of *chermocki*, are subdued by fulvous-colored dusting. In each of the northern California populations examined by the authors (Sierra County, Plumas County, and Shasta County) there are intermixed specimens which resemble *epithore*, "sierra" and *chermocki*. In Klamath County, Oregon, occasional examples resemble the Sierran dwarf, although the yellow of the submedian–median row of spots on the hindwings ventrally is more vivid. A moderate dusting of these spots exists which is not unlike examples from both Plumas and Shasta counties.

The authors contend that naming of an entity which exhibits such extreme variability (not only within a single population, but from population to population) would add to the already replete lists of synonymic redundancies. Both *epithore* and *chermocki* are consistent within and among given populations.

Comparison of epithore complex to other species

Confusion apparently exists among the species *toddi* (Holland), *frigga* (Thunberg), *kriemheld* (Strecker), and *epithore.* The authors have included figures of *Boloria toddi ammiralis* (Hemming), *Boloria frigga sagata* (Barnes & Benjamin), *Boloria kriemheld* (Plate III), and representative examples of the *epithore* complex (Plates I, II).

The distinctive feature of *toddi* subspecies (Fig. 13) is found on the forewings. The outer margin is strongly convex towards the middle, and "cut off" near the apical area (Fig. 13, arrows), then concave above the tornal angle, as opposed to a slight, uniform convex curvature of the outer margin of the other species.

The dorsal ground color of *frigga sagata* (Fig. 15) is more somber (less orange) than that found in the *epithore* complex. The black dusting of the basal area of the hindwings dorsally is more extensive in *sagata* than noted among individuals of *epithore.* The discal region of the hindwings ventrally (Fig. 16) is heavily clouded with fulvous scales; in cell M_2 of the submedian–median band, a nearly oval spot occurs in which the upper half is fulvous and the lower half white. This dichromatic spot is not found in *epithore.*

The discal and basal areas of the hindwings ventrally of *kriemheld* (Fig. 18) are completely free of dusting, unlike the *epithore* complex (Fig. 14). The postbasal and submedian bands are in strong contrast to one another; the submedian band is pale yellow and the postbasal band is red–brown to orange–brown. The veins are prominently dusted with black scales on the upper surface (Fig. 17). This characteristic is not typical of any of the *epithore* constituents.

It is hoped that a comparison of the figures will serve to differentiate the four species discussed herein and that utilization of the text will facilitate future determinations.

Conclusions

(1) The *Boloria epithore* complex presently consists of two distinct subspecies. They are: *Boloria epithore epithore* Edwards and *Boloria epithore chermocki* Perkins & Perkins. There also exists a dwarfed mountain form which must remain unnamed because of inadequate criteria for nomenclatorial designation.

(2) A revised treatment of the *epithore* complex is proposed:

603 *epithore* (Edwards), 1864
- a. *e. epithore* (Edwards), 1864
  - ab. *eldorado* (Strand), 1914
  - ab. *wawonae* (Gunder), 1924

b. *e. chermocki* Perkins & Perkins, 1966
ab. *obscuripennis* (Gunder), 1926

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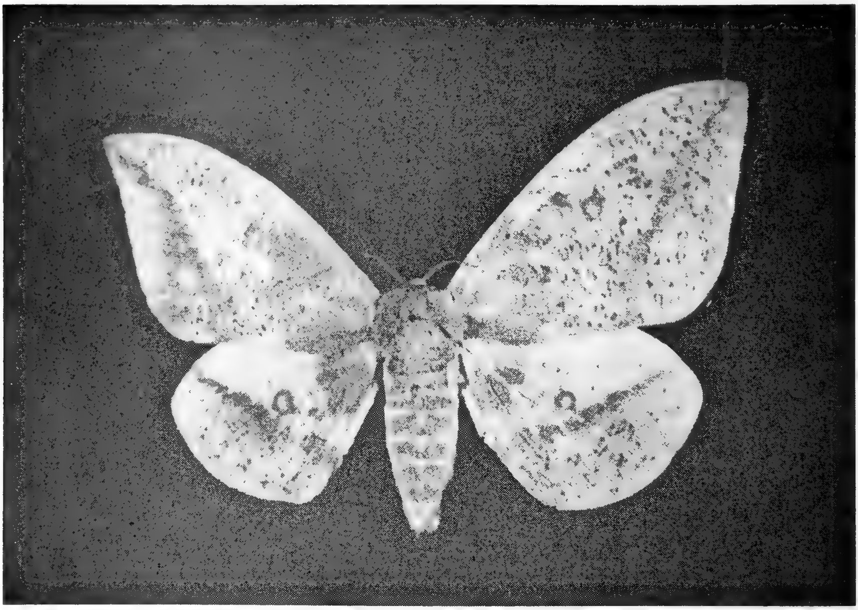
GYNANDROMORPHIC *EACLES IMPERIALIS*

This gynandromorphic specimen of *Eacles imperialis* Drury, shown in Fig. 1, was attracted to black light July 20, 1963, in Pottersville, New Jersey. It hovered over a dark driveway about 50 feet away from black light when it was picked up by my partner, Don Ohlke. It is now in the author's collection. It is a perfect specimen and may be briefly characterized as follows:



Left side, male wing much smaller than female wing, both wings of average size of natural specimens, respectively. Markings on both sides normal above. Antenna on male side normal, on female side, female dorsally, male ventrally with lashes shorter than on male side. Thorax with more yellow between and behind tegulae than average male and female. Abdomen female side a little wider than male side, tapering to normal male anal end. On underside postmedial line completely missing on both fore- and hindwing of female side, a weak postmedial line on male side, missing on other male specimens. All six legs of a much deeper rose color than found on natural specimens.

JOSEPH MULLER, *R.D. No. 1, Lebanon, New Jersey*

TECHNIQUES FOR REDUCING MORTALITY WHEN REARING LARVAE OF CECROPIA MOTH (SATURNIIDAE)

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Considerable difficulty has been experienced in the past in rearing larvae of *Hyalophora cecropia* (Linneaus) in confinement. Dr. J. M. Cameron, head of the Insect Pathology Research Institute at Sault Ste. Marie, Ontario, observed (personal communication) that larvae are extremely sensitive to handling and often die after being moved to new food. Mortality was reduced by allowing larvae to crawl to new food by themselves, but losses were still excessive. Dr. Cameron suggested larvae be caged on growing vegetation, but this requires considerable equipment. Villiard (1964) achieved 95% success in rearing larvae caged outside compared to only 60% when reared indoors. He noted that larvae reared indoors produced smaller adults.

Rearing of 182 larvae from eggs laid by one female was attempted in 1963. While mortality occurred at all stages of development some critical periods were evident. Mortality peaks were associated with first- and last-instar larvae and during molting and pupating. Mortality of first-instar larvae was highest during the first three days after hatching, then gradually tapered off. Larvae appeared to have increasing difficulty with successive molts, the mortality rising each time. In later stages it was observed that the outer skin usually adhered firmly to all but the first four or five segments and in most cases remained unbroken. After a few hours the skin hardened and sometimes cracked or flaked in an irregular pattern. Before the final instar and immediately following an abortive attempt to molt, several larvae were able to push their feet and prolegs through the old skin and resume feeding, but none survived.

Last-instar larvae suffered the heaviest mortality. The earliest abnormal symptom was a brownish mottling just beneath the surface of the skin which increased in area and intensity as pupation approached. Several days after the mottling appeared a brownish fluid discharged from the anus and formed a heavy crust. The frass became damp and greenish in color. In another day or two, larvae appeared to be grossly distended when viewed from above but were, in fact, simply "flattened out." Locomotion and muscular coordination became difficult. Feeding eventually ceased entirely and the larvae succumbed after lingering for as long as three weeks.

Pupating larvae also had difficulty completing their molt. Cocoons

were evaluated on the basis of weight and the light ones were opened after a month or so. Again there was the evidence of the stretching of the skin over the first few segments, but not sufficient to break it. Dehydration apparently had set in very quickly, causing the marked loss of weight. Secondary fungus infection invariably occurred, probably hastening the process. Virus disease was suspected and one of the affected specimens was sent to the Insect Pathology Research Institute at Sault Ste. Marie, but no virus infection could be detected.

During the 1963 rearing, the larvae had been housed in a single cardboard box and were considerably overcrowded. Moreover, the room in which they were placed became excessively hot. In 1964 a cooler room was provided, and more boxes were used with fewer larvae in each box. The Manitoba maple supplied for food was kept fresher by placing it in water, although *Cecropia* larvae seemed to show little preference for fresh food when it was provided, frequently clinging to a fresh leaf while crunching away at a dehydrated remnant of an earlier feeding.

Young larvae in the 1963 rearings had been removed from the old food with a small piece of paper deftly slid under them. They were then dropped onto the new food by lightly tapping the paper. In later stages they were allowed to crawl to the new food unless they had attached themselves to the covering net, in which case they were plucked off by hand. Following Dr. Cameron's advice, it was decided that the bulk of the larvae would not be handled at all during subsequent rearings.

In May of 1964 Mr. C. E. Brown of the Calgary Forest Entomology and Pathology Laboratory supplied me with eight cocoons. A particularly large male was mated with three females and a fourth female was mated with a different male. Approximately 700 eggs were obtained and most of them produced larvae. It seemed probable that careful observation during rearing would provide the key to reduced mortality. Consequently, the larvae were scrutinized by both my wife and myself for several hours each day.

The effects of handling were studied on a sample of about 50 larvae. Those that dislodged readily suffered little damage, but those removed with difficulty were invariably injured. When placed on the new food they raised the posterior segments and frequently clung to the food only with the thoracic legs. Feeding ceased at once and all died within 24 hours, most of them still maintaining the unnatural posture. When forced removal was stopped, mortality declined immediately and no losses were incurred in young larvae after the third day.

On the fifth day following emergence of the larvae my wife noted that

when supplied with their morning food they tended to congregate around the stems, particularly at the cut end. The larvae appeared to be attracted either by the water in which the stems had been immersed, or the sap, or possibly both. The groups dispersed after 10 or 15 minutes and commenced feeding on the leaves. Small droplets of water were placed on the leaves to study the reactions of larvae. They were immediately attracted to the droplets which were promptly siphoned up. Moreover, the speed with which the droplets disappeared was quite as astonishing as the insatiable capacity of the larvae. From this point on the food was liberally sprinkled with water (chlorinated) once a day at the morning feeding. At the time of writing, with pupation almost completed, none of the mortality symptoms previously described have appeared. While the cycle is not complete, nearly all of the larvae finished their growth in a very healthy condition.

The problem of handling becomes less important after the first two weeks following hatching and well-grown larvae can be handled without any adverse effect. My six-year-old daughter successfully reared 18 out of 19 larvae using the methods outlined except that in later stages they were handled quite vigorously several times a day to ensure "that they behave themselves properly, eat all their food, and don't fight with each other."

My own losses, starting with 400 larvae selected at about the seventh day, have been held to less than 3% and this small mortality is attributed to overcrowding and freak accidents. Nearly all larvae came through in a healthy, fully fed, clear-skinned condition.

Results indicate that *Hyalophora cecropia* larvae can be reared successfully indoors, using improvised rearing equipment, providing that the following two requirements are met:

1. No handling of first- and second-instar larvae.
2. Supply adequate water at least once every 24 hours by sprinkling the leaves of the food plant.

Acknowledgments

The author gratefully acknowledges the assistance of Mr. G. R. Hopping, Forest Entomology and Pathology Laboratory, Calgary, Alberta, for his assistance in the preparation of this manuscript.

Literature Cited

Villiard, P., 1964. Multicolored world of caterpillars. Natural History, 73: 24–30.

BEHAVIORAL NOTES ON *MARPESIA PETREUS*

While collecting and studying the distribution of certain Lepidoptera for Peabody Museum, Yale University, in Florida, during June, 1964, I had two encounters with *Marpesia petreus* (Cramer) worthy of note to lepidopterists.

On June 22, at Belle Glade, Palm Beach County, a male flew into our 6-watt G.E. black light at 9:10 P.M.

On June 21, at Ochopee, Collier County, a specimen was netted which showed crisp beak marks, removing the protruding apex between the fifth subcostal nervule and the radial veins on the forewing.

Evidently the attack was made when the insect was at rest, wings folded, as the beak mark is identical on both forewings.

This specimen is in the Yale collection. When presented to Dr. C. L. Remington he was quick to note that perhaps the protrusion or elongation of the wing in the apex area served a purpose such as enabling this insect to escape its predators by having this tip torn away. This specimen was fresh and showed no other marks.

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BOOK NOTICE

BUTTERFLIES AND MOTHS. By Alfred Werner and Josef Bijok. Norman Riley, Editor. The Viking Press, New York, 1965; 126 pp., 40 colorplates. $10.95.

This studio-size book (9½ × 12 inches) is an English translation, printed in Germany, of a book entitled *Fliegende Kleinodien* (Flying Jewels), originally published in Germany in 1955 and briefly mentioned in The Lepidopterists' News, 10: 223; 1956. There are 42 pages of text giving a general description of butterflies and moths, something about migration, a chapter on the "Gems of the Tropics," and one on early stages.

The plates are magnificent, even the iridescence of some tropical Morphos is faithfully reproduced. There are two plates of European butterflies and three of European moths, some of which are also found in North America. Following these are 34 plates, each showing from two to seven species, mostly showy tropical species, from South and Central America, Africa, Asia, and the East Indies.

Included are such marvelous species as the unbelievably long-tailed moths, *Argema mittrei*, of Madagascar, and *Copiopteryx semiramis*, of Brazil and Venezuela; the huge *Caligo beltrao*, of Brazil, *Stichophthalma camadeva*, of Sikkim, and *Attacus atlas*, of India; the jewel-like *Ancyluris formosissima*, of Peru (Riodinidae), and *Precis cebrene*, of Africa. There are 22 species of *Papilio*, seven of *Morpho*, and 4 of *Ornithoptera*. In all, nearly 200 species are figured. There is a frontispiece showing part of a wing of *Chrysiridia madagascariensis*, much enlarged. The end-papers give the global distribution of some of these species.

This is a book worth owning, especially for those who cannot have the actual butterflies and moths.—E. J. NEWCOMER

A SOUTHWARD MIGRATION OF *VANESSA CARDUI* IN LATE SUMMER AND FALL, 1965

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The summer of 1965 was a notable one for vast numbers of painted lady butterflies (*Vanessa cardui* L.) (Nymphalidae) occurring throughout the western United States. From the last week of June to mid-July, incredible densities of *V. cardui* were encountered in southern Nevada, northern Arizona, southern to northern Utah, western and central Wyoming, and all through Colorado, on a three-week field trip by the first-named author. No favored direction of movement was noted at this time. From mid-July to mid-August, no movement of *V. cardui* was noted in the many areas of Colorado that were visited, and in particular, at Big Spring Ranch near Florissant (Teller County, Colorado) where almost daily observations were made during this period.

Suddenly, however, on August 22 the *Vanessa cardui* located on Big Spring Ranch began flying about due south and south–southwest in vast numbers, and this mass movement, involving every individual seen, continued until August 25. By this date, almost all *V. cardui* had left this area but scattered individuals were observed flying south through August 28, when a cold front moved in and stopped all butterfly activity for several days. From August 22 to 25, the *V. cardui* in the entire area between Florissant and Wilkerson Pass (16 miles to the west on Hwy. 24) also were observed moving south in huge numbers. A count on August 22 at the Ranch gave an average of 10 butterflies per minute flying across a 20-foot line, or 600 per hour! This rate of flight activity continued from as early as 7:00 A.M. to nearly dusk.

Between September 1 and 19, observations in the same area by one of us (R. A. W.) showed that *V. cardui* continued moving southward in reduced but still significant numbers. Again, the movement apparently involved all *V. cardui* individuals located between the Puma Hills in South Park (near Wilkerson Pass) to at least as far east as Florissant. On September 20, a severe cold front moved in and the temperature dropped to 12° F. that night; snow soon followed, and apparently the migration was brought to a halt.

These observations seem to represent the first record of a major southward "return" movement of *Vanessa cardui* in the west; it is known from the work of Abbott and Tilden that this butterfly breeds during the winter in northern Mexico and extreme southern California, flying north

in the spring, often in great numbers. Successive generations during the spring and summer appear to be responsible for the annual northerly appearances of this species. But to the authors' knowledge, the species has never before been observed in a southward, fall "migration."

NYMPHALIS CALIFORNICA IN ILLINOIS AND IOWA

In reference to my article entitled, "*Nymphalis j-album* captured at fluorescent light in Chicago" (Jour. Lepid. Soc., 15: 101, 1961), I would like to make a correction. Recently Mr. R. R. Irwin of Chicago, in checking over some of my specimens and field notes, called to my attention that my *Nymphalis* taken at light was not *N. vau-album j-album* (Bdv. & Lec.) but was *N. californica* (Bdv.). Evidently I had not examined the specimen carefully, since one would never expect to find *Nymphalis californica* this far east, while *j-album* should occur here, even though I had never found it.

The mystery is how did *californica* get to Chicago? It seems impossible for it to fly here across the mountains from the west. One other strong probability is that this butterfly was transported here either by truck or by train from the west while in the pupal stage. It could be that the larva crawled onto a boxcar or a truck and made its chrysalid, then emerged after it arrived in this area. There are trucking places not too far away from the location of capture, as well as train sidings and yards.

Another strange fact occurred, however, in the same year at Cedar Falls, Iowa. While collecting along the railroad tracks to the west part of the city, I captured what I supposed was *j-album*, but it turned out to be another *californica*. The Chicago specimen was collected August 20, 1952, and the one from Cedar Falls was taken August 31, 1952. Catching two specimens in the same month of the same year over 300 miles apart indeed enhances the mystery.

The identity of both of these specimens has been verified not only by Mr. Irwin but also by Mr. Alex K. Wyatt of the Chicago Natural History Museum. According to Mr. Wyatt, my record of finding *N. californica* in Illinois is the only one, to the best of his knowledge.

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RECENT LITERATURE ON LEPIDOPTERA

Under this heading are included abstracts of papers and books of interest to lepidopterists. The world's literature is searched systematically, and it is intended that every work on Lepidoptera published after 1946 will be noticed here. Papers of only local interest and papers from this *Journal* are listed without abstract. Readers, not in North America, interested in assisting with the abstracting, are invited to write Dr. P. F. Bellinger (Department of Biological Sciences, San Fernando Valley State College, Northridge, California, U.S.A.). Abstractor's initials are as follows:

[P.B.] — P. F. Bellinger
[I.C.] — I. F. B. Common
[W.C.] — W. C. Cook
[A.D.] — A. Diakonoff
[J.D.] — Julian Donahue
[W.H.] — W. Hackman
[T.I.] — Taro Iwase
[T.L.] — T. W. Langer
[J.M.] — J. Moucha
[E.M.] — E. G. Munroe
[N.O.] — N. S. Obraztsov
[C.R.] — C. L. Remington
[J.T.] — J. W. Tilden
[P.V.] — P. E. L. Viette

B. SYSTEMATICS AND NOMENCLATURE

Tremewan, W. G., & W. B. L. Manley, "Notes on species of the genus *Zygaena* Fabricius (Lepidoptera: Zygaenidae) from south-west France and Spain, with descriptions of new subspecies." *Ent. Rec. & Jour. Var.*, 77: 3–11. 1965. Describes as new *Z. fausta fassnidgei* (Jaca, Spain, 2,700 feet), *Z. occitanica huescacola* (Sierra de la Pena, Huesca, 3,600 feet), *Z. loti soriacola* (Abejar, Soria, 3,300 feet), *Z. hippocrepidis marujae* (Jaca, Huesca, 2,700 feet); also 1 "form" & 1 "ab." Records of 28 other populations. [P. B.]

Urbahn, Ernst, "Neue Untersuchungen zur Klärung der *Aricia agestis* Frage nach Beuret (Lycaenidae)" [in German]. *Mitteilungsbl. Insektenkunde*, 5: 101–107. 1961. The distinguishing characteristics of *A. agestis, A. allous,* & *A. montensis* are given. [J. M.]

Urbahn, Ernst, "Genitalvariabilität bei *Hydraecia nordstroemi* Horke (Lep. Noct.)" [in German]. *Deutsche ent. Zeitschr.*, N.F., 9: 264–270, 10 figs. 1962. Compares *H. nordstroemi* with *petasitis, micacea,* & *amurensis*, figuring genitalia of both sexes. The first sp. is uniform in Scandinavia, but variable in size, pattern & genitalia in its Asiatic range. [P. B.]

Vári, L., "Neue afrikanische Microlepidoptera" [in German]. *Deutsche ent. Zeitschr.*, N.F., 10: 1–12, 1 pl., 19 figs. 1963. Describes as new *Microsetia parilis* (Little Akaki R., Ethiopia; on *Achyranthes aspera*), *M. isocharis* (Louis Trichardt, Transvaal; on *A. aspera*), *M. mimetis* (Drummond, Natal; on *A. aspera*); *Stomphastis heringi* (Little Akaki R., Ethiopia; on *Croton macrostachys*); *Metriochroa carissae* (Little Akaki R.; on *Carissa edulis*), *M. scotinopa* (Dabra Zeit, Ethiopia; on *Dregea schimperi*); *Porphyrosela homotropha* (Little Akaki R.; on *Glycine javanica*). Transfers *Scobipalpa turgida* to *Ephysteris* (foodplant *Balanites aegyptiaca*). Records foodplants of *Dialectica carcharota* (*Cynoglossum hochstetteri*) & *Acrocercops chretiae* (*Ehretia cymosa*). [P. B.]

Varin, G., "Les sous-espèces françaises d'*Hipparchia fagi* Sc., *alcyone* Denis et Schiff. et *neomiris* God. (Satyridae)" [in French]. *Alexanor*, 2: 313–324. 1962. Subspecies of these satyrids in France. Description of *H. f. fuxiensis* (western Pyrenees, Médine) & *H. a. faronica* (Var, Mont Faron) named by the author as "sous-race" of *H. a. sogdiana*. [P. V.]

Vartian, Eva A., "Eine neue *Celama* Hb. aus Afghanistan (Lepid., Nolidae)" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 131–132, 3 figs. 1963. Describes as new *C. kreuteli* (Paghman, 30 km. NW of Kabul, 2,100 m.). [P. B.]

Viette, P., "Les Epipyropides de Madagascar (lépidoptères parasites)" [in French]. *Lambillionea*, 60: 41–46, 2 figs. 1960. Describes as new *Epipyrops grandidieri* (W. Madagascar, Antsalova district, Andobo, Antsingy Forest, 190 m.), *E. radama*

(central Madagascar, Ambatolampy district, Ampolomita, E. of Belanitra, 1,400 m.). Note on locality of *E. malgassica*. Reviews literature on the family. [P. B.]

Viette, P., "Description d'un nouvelle *Apaturopsis* de Madagascar (Lep. Nymphalidae Apaturinae)" [in French]. *Bull. Soc. zool. France*, 86: 670–672, 2 figs. 1961. Description of the new nymphalid *A. paulianii* (S.W. Madagascar, Analavelona Mts.). [P. V.]

Viette, P., "Descriptions préliminaires de nouvelles espèces de noctuelles de Madagascar, IV (Lep. Noctuidae)" [in French]. *Bull. Soc. ent. France*, 66: 42–54. 1961. Preliminary descriptions of Noctuidae from Madagascar: *Ochropleura marojejy* (Marojejy Mts.); *Timora pauliani* (Antsingy Forest); *Omphalestra herbuloti* (Betsileo Land); *FLETCHERA* (Cuculliinae), & type *F. pauliani* (Betsileo Land), *F. humberti* (Marojejy Mts.), *F. pratti* (Perinet), *F. perrieri* (Andringitra Mts.); *TUNOCARIA* (Cuculliinae), & type *T. rubiginosa* (Ambre Mt.); *Eutamsia milloti* (Lakato Road); *KENRICKODES* (Amphipyrinae) (type species: *Perigea rubidata* Kenrick); *Athetis radama* (Ambre Mt.); *Ethioterpia toulgoeti* (Nossi-bé); *Selenistis pauliani* (Ampanihy); *DECARYNODES* (Amphipyrinae), & type *D. ankasoka* (Lakato Road); *Procrateria malagassa* (Befasy Forest); *Epicausis griveaudi* (Betsileo Land). [P. V.]

Viette, P., "Les Noctuidae Hyblaeinae de Madagascar (Lep.)" [in French]. *Bull. mens. Soc. linn. Lyon*, 30: 191–194. 1961. Study of the three spp. of Hyblaeinae from Madagascar. Describes as new *H. paulianii* (W. Madagascar, Antsalova) & *H. madagascariensis* (W. Madagascar, Ankarafantsika). [P. V.]

Viette, P., "Les Yponomeutidae de la faune de France (lépidoptères)" [in French]. *Entomologiste*, 16: 102–106. "1960" [1961]. List of the species for the fauna of France according to the revision of the palearctic Yponomeutidae by G. Friese (1960). [P. V.]

Viette, P., "Noctuelles quadrifides de Madagascar nouvelles ou peu connues" [in French]. *Mém. Inst. scient. Madagascar, (E)*, 2: 171–190, 1 pl., 5 figs. "1961" [1962]. New or little-known quadrifids from Madagascar. Describes as new: *Corgatha neona* (E. Madagascar, Perinet), *C. funebris* (Perinet), *C. roseocrea* (E. Madagascar, Anosibe Road); *Cerynea veterata* (Perinet), *C. oblops* (Perinet); *Sophtha rimosa* (Perinet), *S. peroma* (Anosibe Road), *S. mazoatra* (Perinet), *S. incerta* (Perinet), *S. microplexia* (E. Madagascar, Integral Natural Reserve 3); *Hypersophtha priscata* (Anosibe Road); *Hypobleta festiva* (Perinet), *H. fatua* (central Madagascar, Betsileoland), *H. viettei orientalis* (Anosibe Road) (Jaspidiinae = Erastrinnae); *Herpeperas tanda* (Integral Natural Reserve 3), *H. atra* (same); *Catalana sandrangato* (Anosibe Road); *Rhoesena helcida* (Perinet) (Othreinae); *Olybama inversa* (E. Madagascar, Italaviana), *O. incerta* (Perinet), *O. discoidea* (Anosibe Road); *Progonia boisduvalalis* (Anosibe Road); *Adrapsa luma* (Perinet). [P. V.]

Viette, P., "Nouveaux Lasiocampidae de Madagascar (Lep.)" [in French]. *Bull. mens. Soc. linn. Lyon*, 31: 215–227. 1962. Descriptions of new Lasiocampidae from Madagascar: *Chrysopsyche pauliani* (S. of Morondava); *Raphipeza pratti* (Perinet), *R. perineti* (same), *R. turbata orientalis* (same); *Lechriolepis ramdimby* (Midongy du Sud), *L. fulvipuncta* (Italaviana); *Closterothrix goudoti* (Ranomafana), *C. insularis* (Lakato Road), *C. nigrosparsata* (Sakaraha); *Odontocheilopteryx malagassy* (Perinet), *O. meridionalis* (Morombe); *Schausinna goliath* (Midongy du Sud); *Ochanella hova* (Ankaratra Mts.), *O. virginalis* (Tuléar); *Libethra aurantiaca* (Ankarafantsika), *L. ochracea* (same), *L. sparsipuncta* (Antsalova); *Borocera tamsi* (Tananarive). No figures. [P. V.]

Viette, P., & P. Griveaud, "Nouvelles espèces malgaches de noctuelles quadrifides (lépidoptères)" [in French]. *Bull. Acad. malgache*, 38: 53–62, 14 figs., 1 pl. "1960" [1962]. Descriptions of new quadrifid noctuids from Madagascar: *Ulotrichopus marmoratus* (Andringitra Mts.); *Cerocala vermiculosa megalesia* (Far South, Ambovombe), *C. decaryi* (same), *C. subrufa* (Ankarafantsika area, Ampijoroa) (Catocalinae); *Tariodes virgata* (Ampijoroa); *Bamra jucunda* (Faraony

Valley, Vohilava); *Paralephana umbrata* (Anosibe Road); *Parathermes brunneoaspersus* (Sakaraha); *Khadira formosa* (Ampijoroa) (Othreinae). [P. V.]

Wakely, S., "Notes on *Tinea turicensis* Mull.-Rutz (*metonella* Pierce)." *Ent. Rec. & Jour. Var.*, 74: 92–93. 1962. Taxonomic history; record from England, feeding in fur and feathers. [P. B.]

Wangermez, J., "Les hyponomeutes de France" [in French]. *Proc.-verb. Soc. linn. Bordeaux*, 97: 29–35, 1 pl. 1958. Study of the species of *Yponomeuta*, chiefly according to Toll (1941), and essay of a key to the species. [P. V.]

Warnecke, Georg, "Die Verbreitung von *Ogygia forcipula* Hübner und von *O. nigrescens* Höfner in Deutschland und einigen Nachbargebieten (Lep. Noct.)" [in German]. *Nachrichtenbl. bayer. Ent.*, 10: 119–123, 3 figs. 1961. Distinguishes these spp. (external characters & genitalia); maps central European records. [P. B.]

Warnecke, Georg, & Karl Cleve, "*Noctua* (*Triphaena*) *orbona* Hufn.: Die gelbe Bandeule mit schwarzen Costalfleck de Vorderflügel" [in German]. *Zeitschr. wiener ent. Ges.*, 48: 212–216. 1963. Discussion of application of the name *orbona*, agreeing with Boursin & opposing Hydemann's opinion that *orbona* = *comes*. [P. B.]

Warren, B. C. S., "*Erebia melas carpathicola* Popescu-Gorj & Alexinschi (Lep. Satyridae) in west Transylvania." *Entomologist*, 94: 171–172. 1961. New record & descriptive notes. [P. B.]

Warren, B. C. S., "The androconial scales and their bearing on the question of speciation in the genus *Pieris* (Lepidoptera)." *Ent. Tidskr.*, 82: 121–148, 72 figs. 1961. Describes as new *P. higginsi* (Haji Omran, Iraq, 5,000–5,500 ft.). Describes these scales in sspp. of *rapae, napi,* & *melete* groups, and in races of *P. napi* & *P. bryoniae* especially. The former "races" *leucosmoa, dulcinea, japonica, pseudorapae, segonzaci, venosa, narina, nesis,* & *orientis* are regarded as specifically distinct. The independence of *P. napi* & *P. bryoniae* is supported by the tendency to abnormality in the androconia of hybrids, while these scales in *P. n. napi* × *P. n. adalwinda* hybrids are intermediate and normal. Seasonal variation in *P. b. "flavescens"* from Hasli Tal, Switzerland, is described from bred specimens. *P. napi* is considered entirely palearctic; North American races belong to *bryoniae* or to *venosa* (including *virginiensis*). [P. B.]

Warren, B. C. S., "Some overlooked details from Hohenwarth's description of his *Papilio cassioides.* (Lep., Satyridae)." *Ent. Rec. & Jour. Var.*, 74: 53–56. 1962. Reemphasizes that *cassioides* (= *nivalis*) is round-winged from Glockner region; discusses *dolomitensis* & other races in this complex. [P. B.]

Warren, B. C. S., "*Pieris bryoniae dubiosa* Rober, and notes on variation in the androconia of *Pieris* species." *Ent. Rec. & Jour. Var.*, 75: 125–129, 1 pl. 1963. Refers *dubiosa* to *P. bryoniae* on the basis of androconial structure, and discusses variation and taxonomic importance of these scales in *P. napi, P. bryoniae,* their hybrids, etc. [P. B.]

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book on the Sugar-Beet Moth, its life history, taxonomy, and control. The sp. was observed in Southern Czechoslovakia. All methods of its control are described. In Slovak with summaries in Russian, English, & German. [J. M.]

Whalley, Paul E. S., "A new species of *Midila* from S. America (Lep. Pyralidae). *Midila sulphurata* sp. nov." *Agros*, Pelotas, 10: 47–48, 1 pl. 1957. Type locality Alto da Serra, S. Paulo, Brazil. [P. B.]

Whalley, Paul E. S., "*Cadra woodiella* R. & T., a synonym of *C. parasitella* Staud. (Lep., Pyralidae)." *Ent. Gazette*, 12: 113. 1961. Selects lectotype of *C. parasitella*. [P. B.]

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Whalley, Paul E. S., "*Euzophera osseatella* Treitschke (Lep., Phycitinae) on potatoes imported from Egypt to Scotland." *Ent. Gazette*, 14: 100. 1963. Sinks *E. arcuatella* to *E. osseatella* & *E. stramentella* to *E. villora*; selects lectotypes. [P. B.]

Whalley, Paul E. S., "The status of *Myelois neophanes* (Phycitinae) in England." *Jour. Lepid. Soc.*, 17: 39. 1963.

Whalley, P. E. S., & M. W. F. Tweedie, "A revision of the British Scoparias (Lepidoptera: Pyralidae)." *Ent. Gazette*, 14: 81–98, 12 pls. 1963. Divides the 14 British spp. between *Scoparia* (type *pyralella*) & *Witlesia* (type *pallida*). Annotated catalogue including all "forms," with figures of wings. [P. B.]

Wiltshire, E. P., "A new genus, eight new species, seven new forms, and notes on Lepidoptera of Saudi Arabia, Bahrain, and Iran." *Jour. Bombay nat. Hist. Soc.*, 58: 608–631, 4 pls., 3 figs. 1961. Actually 10 new species are described. Describes as new: *Celama harouni dilmuna* (Bahrain; foodplants: *Prosopis stephaniana*, trefoil); *Victrix sassanica* (SW Iran, Fars, Pireh-Zan, 7,000 ft.); *Cryphia polyphaenoides* (Bahrain, Adari Pool Gardens); *Porphyrinia rushi* (Bahrain, near Amar, southern desert), *P. bistellata* (same locality), *P. pallidula khalifa* (Bahrain, desert), & new "form"; *Catocala timur richteri* (S. Iran, Iranshahr, 800 m.); *Anumeta asiatica* (S. Iran, Khuzistan, Ahwaz, 400 ft.), *A. eberti zaza* (S. Arabia, Sawada), *A. arabiae* (Arabia, Nejd, Dahana, Awania); *Armada fletcheri* (SW Iran, Kuzistan, Ahwaz, 200 ft.); *RIADHIA*, & type *R. diehli* (Saudi Arabia, Riadh); *Lygephila fereidum* (N. Iran, Elburz Mts., Lar Valley, 9,000 ft.); *Antarchaea pyralomina* (Saudi Arabia, El Riadh); *Rhynchodontodes orientis richteri* (S. Iran, Makran, Tiz near Putab). Transfers *Lambessa gibbonsi* to *Beralade* & names new "ab."; new synonymy of *Euproctis cervina;* sinks *Porphyrinia tomentalis* to *P. bulla*. [J. D.]

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Wolff, L. Niels, "Zur Identifizierung einiger dänischen, von A. Caradja als nov. spp. erwahnten, Lepidopteren" [in German; Russian & Rumanian summaries]. *Trav. Mus. Hist. nat. "Gr. Antipa,"* 2: 183–188, 4 figs. 1960. *Lithocolletis coryli* Nic. (= *L. danica* Caradja), *L. maestingella* Zell. (= *L. hedemanni* Caradja); *Parornix anglicella* Stt. (= *P. rubiella* Caradja), *P. scoticella* St. (= *P. cotoneastri* Rbl. in litt. in Caradja 1920); new synomymy. [J. M.]

Wolff, Niels L., "*Horisme corticata* Tr. (Lepid. Geom.) fundet i Danmark" [in Danish; English summary]. *Ent. Meddelelser*, 31: 21–26, 2 figs. 1961. New record. ♂ genitalia of *corticata, aquata, tersata,* & *vitalbata* figured. [P. B.]

Wyatt, Alex K., "A new subspecies of *Holomelina aurantiaca* from Virginia (Arctiidae)." *Jour. Lepid. Soc.*, 17: 100–102, 2 figs. 1963. Correction, 18: 118. 1964. Describes as new *H. a. buchholzi* (Suffolk, Virginia).

Wyatt, Colin W, "Zwei für das paläarktische Faunengebiet neue Tagfalterarten" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 97–100, 1 pl. 1961. Describes as new *Clossiana alberta kurenzovi* (Tschukotka Mts., NE Siberia), *C. distincta tschukotkensis* (same locality). [P. B.]

July 5, 1966

Mr. Don B. Stallings
Entomology Section
Yale University
Peabody Museum of Natural History
Caldwell, Kansas 67022

Dear Mr. Stallings:

Your letter of July 6 arrived while I was in Brazil and only this morning was I able to meet with my colleagues here.

Because of other national and international meetings scheduled for 1968, we suggest June 15-19 as approximately the time the Lepidopterists' Society meetings should be held. We did not have a 1968 calendar handy so an adjustment can be made to provide a weekend for travel to Washington.

The following committees should be appointed:

2) Transportation

3) Banquet

We believe that the subcommittee on papers can best be handled by the society (i.e. from your end) with at least one member on the committee from here. The subcommittees a, b and c and committees 2 and 3 can best be handled here. On these subcommittees and committees I should like to suggest that at least Bob Mitchell, John Fales and George Rawson be included and they can coordinate their activities with individuals here and with members arranging for the presentation of papers.

Excursions could include visits to the Patuxent Wild Life Refuge, Plummers Island, Blue Ridge Mountains and the Chesapeake Bay area.

We suggest also that Kettlewell (on melanism) or Roeder from Tufts (bat evasion by moths) or some similar individual of world reputation be brought in as a feature speaker. Any such person would draw an audience of not only lepidopterists but also individuals

Clarke

July 5, 1966

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Entomology Section
Yale University
Peabody Museum of Natural History
Caldwell, Kansas 67022

Dear Mr. Stallings:

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Because of other national and international meetings scheduled for 1968, we suggest June 13-19 as approximately the time the Lepidopterists' Society meetings should be held. We did not have a 1968 calendar handy so an adjustment can be made to provide a weekend for travel to Washington.

The following committees should be appointed:

1) Program
   a. papers
   b. excursions
   c. Ladies' entertainment

2) Transportation

3) Banquet

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JFGClarke:st

in other disciplines and members of Entomological Society of America, Entomological Society of Washington and Biological Society of Washington. I am sure the secretary of the Smithsonian would be willing to pay expenses for such a feature speaker.

All of us here would favor a symposium on a subject of broad interest as an inclusion in the program.

I hope this will give you a start. Unfortunately, I am leaving here on the 14th for an extended trip and will not be in communication again until about the middle of December when I can be reached at the Department of Entomology, British Museum (Natural History) in London. I shall be back in Washington sometime next spring (1967).

With best wishes,

Sincerely yours,

J. F. Gates Clarke
Senior Scientist

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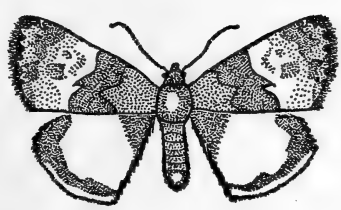

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CONSTITUTION AND BY-LAWS

(Complete contents on back cover)

25 August 1966

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Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

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JOURNAL OF THE LEPIDOPTERISTS' SOCIETY

Volume 20 1966 Number 3

SOUND PRODUCTION IN PUPAE OF LYCAENIDAE

JOHN C. DOWNEY

Southern Illinois University, Carbondale, Illinois

Most of the research being undertaken on sound production in insects involves only the adult stage. Perhaps this is due to the obvious nature of the noise in adults of certain groups, for example, cicadas, crickets, and even mosquitoes, as well as the ease with which certain behavioral activities (e.g., courtship) can be related to sound production. Significantly less information is available on sound production and reception in immature stages. For example, we were amazed to note during this study that the pupa of the common monarch butterfly, *Danaus plexippus* (Linn.), makes a very audible clicking sound at certain times. Since this species has probably been reared more often than any other Nearctic butterfly, and is often used in texts to illustrate life history stages, one would think that this aspect of its behavior would surely have been reported. However, it appears no one has previously noted sound in monarch pupae, let alone in less commonly reared species. Since the pupal stage is inactive in most butterflies, showing little or no external response to stimuli, the question of how and why noises are produced is perplexing.

It is the purpose of this paper: 1) to bring together the scattered information on sound in pupae of Lycaenidae; 2) to note the occurrence of the organs which produce sound in a great number of species and, equally important; 3) to record those species which lack stridulatory devices; 4) to describe and compare the sound producing structures within the family, correlating findings with previous taxonomic arrangement as determined by adult taxonomy; and 5) to present some inferences on the origin and function of pupal sound in Lycaenidae.

Frings and Frings (1960) provide a valuable bibliography on sound production and reception in insects. They list 24 orders, and over 280 families about which some information is available. Somewhat sur-

prising is the fact that representatives of at least 40 families of Lepidoptera produce sound at one stage or more in their life cycles.

According to Prell (1913: 500), Kleeman in 1774 was the first naturalist to record that a lycaenid pupa could produce sound. Over 100 years passed before Schild (1877) also reported slight noises from pupae of the same species, *Callophrys rubi* (Linn.). DeNiceville (1900) noted that "creaking noises" are commonly produced by lycaenid pupae, but he only mentioned one species directly, *Rapala lankana* Moore. Most references to sound-producing pupae are scattered in the vast literature dealing with life histories of various species, and for the most part, they consist of brief statements that sound was heard. Since 1900 a chronological arrangement of authors noting sound would include: Bethune-Baker (1905), Prell (1913), Dodd (1916), Roepke (1918), Bell (1919a, b, c, 1920), Thorn (1924), Jackson (1937), Carter (1952), Clench (1961), and Downey and Strawn (1963).

Two workers have made very substantial contributions to the knowledge of pupal sound in the Lycaenidae. Prell (1913) described the noise in *Thecla quercus* (Linn.) and discussed the structures involved. His very accurate drawings of the stridulating devices in that species provide an excellent foundation on which to add our observations. Although Prell quoted earlier workers in stating that *C. rubi* produced sound, and added that he heard the noise in *Strymonidia spini* Schiff., no details concerning these species were given. Hinton (1948) summarized the general literature on pupal sound in the Lepidoptera, and presented four types of mechanisms involved: 1) body knocked against substrate or walls of pupal cell; 2) one or more pairs of abdominal segments rubbed together; 3) abdomen rubbed against proboscis; and 4) ridges or tubercles of pupa rubbed against walls of cocoon. Thirteen Lycaenidae, all previously reported, were included in Hinton's categories one and two above.

The sound produced by lycaenid pupae have been described variously as "chirping," "creaking," "ticking," "buzzing," "humming," or "clicking" noises. We first noted the sound in 1962 after placing in a single vial two dozen pupae of *Lycaena thoe* Guer. The container acted as a reflecting surface and the sounds produced were distinctly audible. Subsequently we were forced to use small vials held close to the ear, often in a closet or room where ambient noises were reduced, to detect the subtle noises produced by single individuals of other species. We were able to associate the sound with extremely rapid movements of abdominal segments, particularly posterior to segment five, and our attention was drawn to the distinct intersegmental region between abdominal segments five and six (see Plate I, Fig. 1). Slide preparations

of sections from this region disclosed the mircoscopic stridulatory organs described below. Having thus associated sound with the structures involved, it was then possible to examine a cast pupal skin often retained with the adult in reared material, and make a judgment whether or not sound could be produced by the living pupa.

Table I is a list of all Lycaenidae which were found to have stridulating devices in the pupae or which have been reported as sound producers. For the sake of completeness, all references have been included in addition to columns indicating whether the sound was heard, or only the stridulating structures observed. The organs were noted for the first time in three species (*Strymon melinus, Strymonidia spini,* and *S. w-album*) which were previously reported as sound producers. As indicated in Table I, all records are new for the subfamily Riodininae and for the tribes Gerydini, Lycaenini, and Plebejini in the subfamily Lycaeninae. The addition of 57 species to the 25 previously reported represents a considerable increase in our knowledge of the occurrence of pupal stridulation in the family.

Sound producing structures were not found in all species examined. *Glaucopsyche lygdamus* Dbldy., *Philotes mohave* Wats. & W. P. Comst., and *P. rita* B. & McD., lacked the structure. Since these species belong to the same tribe (Glaucopsychini) it is strongly suspected that other related genera, i.e., *Phaedrotes, Iolana,* and *Maculinea,* may also lack sound-producing organs. However, the presence of the structures in 40 genera of rather diverse taxonomic subgroups suggests that the occurrence of sound production is widespread within the family.

Statements and drawings in published accounts of life cycles gave us evidence that other lycaenids have sound-producing structures although stridulation was not mentioned. Photographs of the pupae of *Gerydus boisduvali* Moore by Roepke (1918) and *Agriades escheri* Hbn. by Chapman (1916), and a drawing of *Liphyra brassolis* Westw. by Bethune-Baker (1924) all show either a prominent dorsal ridge on the fifth tergite or a marked depression between abdominal segments 5 and 6, or both. In addition, statements in other papers are highly suggestive of stridulatory movements. Zikan (1935: 411) noted that pupae of *Nymula brennus* Stichel were able to execute lateral movement between the fifth and sixth abdominal segments. Dickson (1952: 455) wrote that the abdomen of *Phasis zeuxo zeuxo* L. has a limited degree of flexibility. He stated that when a pupa was touched, the portion of the abdomen beyond the fourth segment was seen to move with a "rapid, almost trembling motion." Perhaps these workers noted only the movements, but did not check for sound and consequently missed slight noises in-

volved. Even though highly suspected, the above species have not been considered as sound producers in Table I.

Six species belonging to the genera *Hypolycaena*, *Iolaus* (both subgenera *Argiolaus* and *Epamera*), and *Narathura* have pupae which will hammer rapidly against a leaf or twig substrate with their anterior end. Presumably the flexibility permitting this hammering is between abdominal segments. Jackson (1937: 214) indicates that when alarmed the pupa can make sufficient noise, by hammering, to frighten away a small predator. Dodd (1916) has reported that an Australian species of *Narathura* stridulates, while Bell (1919b), who was well acquainted with both types of noise making, noted only hammering in an Oriental *Narathura*. Perhaps both types of noise production are possible in a single species with extremely flexible abdominal segments, and it would not surprise me to find stridulatory organs in pupae of all six species reported as hammerers in Table I.

For convenience in the following discussion only the trivial scientific name of the lycaenids will be used. The generic name and author of each species is given in Table I. Two other usages should be noted. I have followed Mosher (1916) in saying that a particular abdominal segment is movable when motion is possible between its sclerotized caudal margin and the segment posterior to it. Snodgrass (1935, Fig. 39: 77) indicates that it is the posterior part of each segment which forms the infolded conjunctival membrane in typical secondary segmentation. The true intersegmental groove in primary segmentation does not usually coincide with the extant intersegmental membrane but is often posterior to it. Whatever the nature of origin, I will be assigning the entire intersegmental region to the segment anterior to it, regardless of any possible ontogenic contribution of the posterior segment. "Membrane 4" as used below refers then to the usually infolded intersegmental region between segments 4 and 5. It should also be pointed out that certain sclerites of the pupae are ill-defined and the use of the morphological term "tergite" is for convenience; the stigmatal lines (an imaginary line between adjacent abdominal spiracles) are directly lateral of the "tergite" as that term is herein used.

Sound-producing Structures

The external structures involved in sound production are located on membrane 4 and 5 of the pupal abdomen. They may completely encircle the pupa, but are generally limited to the dorsal region, usually the tergite. All specimens possessing stridulatory structures had them on membrane 5, and members of the subfamily Riodininae had, in addition, a distinct and equally functional apparatus on membrane 4.

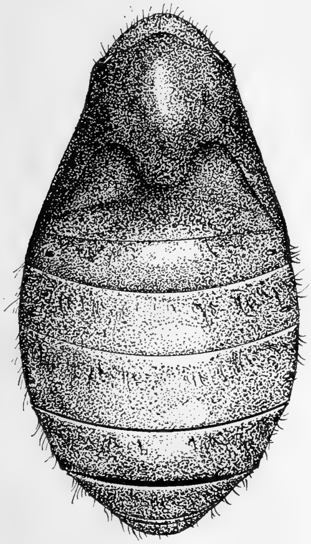

FIG. 1

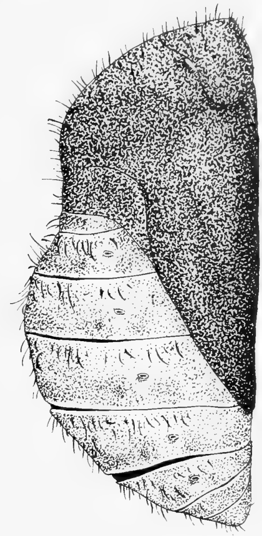

FIG. 2

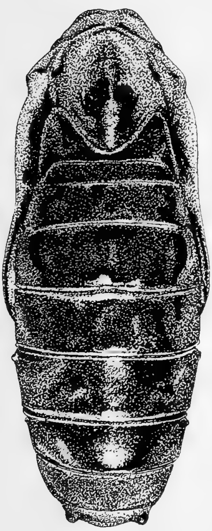

FIG. 3

FIG. 4

EXPLANATION OF PLATE 1

Pupae of Lycaenidae with prominent stridulating regions. Figs. 1, 2. Dorsal and lateral view of the Nearctic *Callophrys* (*Incisalia*) *henrici* Grote & Robinson, a rather rigid pupa. The microscopic stridulating organs are limited to the dorsal intersegmental cleft between abdominal segments 5 and 6. Figs. 3, 4. Dorsal and lateral view of the Australian *Ialmenus evagoras evagoras* (Don.), which has greater flexibility of abdominal segments. The organs are found only between segments 5 and 6, but they extend completely around the segment.

TABLE 1. LYCAENIDAE WITH SOUND-PRODUCING PUPAE

Species	Realm	Type	Sound Heard	Organs Noted	Reference
Riodininae					
Ancylurini					
Anatoli rossi Clench	Neo.	Str.		X	new
Apodemia mormo virgulti (Behr)	Nea.	Str.		X	new
A. m. deserti (B. & Mcd)	Nea.	Str.	X	X	new
Lephelisca wrighti (Holl.)	Nea.	Str.		X	new
Lycaeninae					
Miletini					
Allotinus horsfieldi Moore	Or.	Str.	X		Roepke, 1918
Gerydini					
Feniseca tarquinius (Fabr.)	Nea.	Str.		X	new
Lycaenini					
Lycaena (*L.*) *helloides* (Bdv.)	Nea.	Str.		X	new
L. phlaeas (Linn.)	Nea.	Str.	X	X	new
L. thoe Guer.	Nea.	Str.	X	X	new
L. virgaureae (Linn.)	Pal.	Str.		X	new
L. (*Tharsalea*) *arota* (Bdv.)	Nea.	Str.		X	new
Plebejini					
Brephidium exilis (Bdv.)	Nea.	Str.		X	new
Everes argiades Pall	Pal.	Str.		X	new
E. comyntas (Godt.)	Nea.	Str.	X	X	new
Leptotes marina (Reakirt)	Nea.	Str.		X	new
Lysandra coridon Poda	Pal.	Str.		X	new
L. thersites Cant.	Pal.	Str.		X	new
Plebejus (Icaricia) *acmon* (West & Hew.)	Nea.	Str.	X	X	new
P. (I) *icarioides* Bdv.	Nea.	Str.	X	X	new
P. (Lycaeides) *argyrognomon* Brgster.	Pal.	Str.		X	new
P. (L.) *melissa* Edw.	Nea.	Str.		X	new
P. (*Plebejus*) *argus* (Linn.)	Pal.	Str.		X	new
P. (*P.*) *saepiolus* Bdv.	Nea.	Str.	X	X	new
P. (*Agriades*) *glandon* (Prunner)	Nea.	Str.		X	new
Zizeeria labradus Godt.	Aus.	Str.		X	new
Lampidini					
Ialmenus evagoras Don.	Aus.	Str.		X	new
I. ictinus Hew.	Aus.	Str.		X	new
Jamides celeno Cram.	Or.	Str.	X		Bell, 1919a
Ogyrini					
Ogyris geneoveva gela Waterh.	Aus.	Str.		X	new
O. hewitsoni Waterh.	Aus.	Str.	X		Beth.-Bak., 1905
O. hymetus taygetus Feld.	Aus.	Str.		X	new
O. olane Hew.	Aus.	Str.	X		Thorn, 1924
O. orates Hew.	Aus.	Str.	X		Beth.-Bak., 1905
O. zosine Hew.	Aus.	Str.	X		Beth.-Bak., 1905
Theclini					
Atlides halesus (Cram.)	Nea.	Str.	X	X	new
Callophrys (*Callophrys*) *rubi* (L.)	Pal.	Str.	X		Kleeman, 1774
C. (*C.*) *sheridani* (Carpenter)	Nea.	Str.		X	new
C. (*C.*) *viridis* (Edw.)	Nea.	Str.		X	new
C. (*Incisalia*) *fotis* (Strecker)	Nea.	Str.		X	new

TABLE 1. Continued.

Species	Realm	Type	Sound Heard	Organs Noted	Reference
C. (I.) henrici (Grote & Rob.)	Nea.	Str.	X	X	new
C. (Mitoura) gryneus (Hbn.)	Nea.	Str.	X	X	new
C. (M.) hesseli Raw. & Zieg.	Nea.	Str.		X	new
C. (M.) johnsoni (Skin.)	Nea.	Str.	X	X	new
C. (M.) loki (Skin.)	Nea.	Str.		X	new
C. (M.) nelsoni (Bdv.)	Nea.	Str.		X	new
C. (M.) spinetorum (Hew.)	Nea.	Str.	X	X	new
C. (Sandia) macfarlandi Ehr. & Cl.	Nea.	Str.		X	new
Calycopis beon Cram.	Neo.	Str.	X	X	new
Chrysophanus titus (Fabr.)	Nea.	Str.	X		Clench, 1961
Dolymorpha jada (Hew.)	Nea.	Str.		X	new
Eumaeus debora Hbn.	Nea.	Str.		X	new
E. minyas Hbn.	Nea.	Str.		X	new
Habrodais grunus (Bdv.)	Nea.	Str.		X	new
Hypaurotis crysalus (Edw.)	Nea.	Str.	X		Clench, 1961
Hypolycaena philippus Fabr.	Eth.	Ham.	X		Clark & Dickson, unpubl.
Iolaus (Argiolaus) silas Westw.	Eth.	Ham.	X		Jackson, 1937
I. (Epamera) alienus Trim.	Eth.	Ham.	X		Clark & Dickson, unpubl.
I. (E.) mimosae Trim.	Eth.	Ham.	X		Clark & Dickson, unpubl.
I. (E.) sidus (Trim.)	Eth.	Ham.	X		Jackson, 1937
Narathura araxes eupolis Miskin	Aus.	Str.	X		Dodd, 1916
N. centaurus F.	Or.	Ham.	X		Bell, 1919b
Eupsyche m–album (Bdv. & LeC.)	Nea.	Str.	X	X	Clench, 1962
Pratapa blanka argentea Aur.	Or.	Str.	X		Bell, 1919b
P. deva Moore	Or.	Str.	X		Bell, 1919b
Rapala lankana Moore	Or.	Str.	X		deNice, 1900
R. Manea schistacea Moore	Or.	Str.	X		Bell, 1920
R. varuna Horsf.	Or.	Str.	X		Bell, 1920
Rathinda amor (Fabr.)	Or.	Str.	X		Bell, 1919c
Satyrium acadica (Edw.)	Nea.	Str.		X	new
S. adenostomatis (H. Edw.)	Nea.	Str.		X	new
S. auretorum (Bdv.)	Nea.	Str.		X	new
S. behrii (Edw.)	Nea.	Str.		X	new
S. saepium (Bdv.)	Nea.	Str.		X	new
S. sylvinus (Bdv.)	Nea.	Str.		X	new
Strymon melinus Hbn.	Nea.	Str.	X	X	Clench, 1961 new
Strymonidia acaciae (Fabr.)	Pal.	Str.		X	new
S. pruni Linn.	Pal.	Str.		X	new
S. spini Schiff.	Pal.	Str.	X	X	Prell, 1913 new
S. w–album Knoch	Pal.	Str.	X	X	Carter, 1952 new
Thecla quercus (Linn.)	Pal.	Str.	X	X	Prell, 1913
Tmolus echion (Linn.)	Neo.	Str.		X	new
Curetini					
Curetis thetis Drury	Or.	Str.	X		Bell, 1919a

Lysandra thersites also had the stridulatory devices on membrane 4, although they appeared slightly smaller than the same structure on 5. Such species as *coridon*, *debora*, and *minyas* had roughened surfaces on membrance 4, rather different than the apparent noise-producing structures on membrance 5, so that their functional nature remains in doubt. It is to be expected that other species, particularly those with flexible abdomens, will be found to have at least two intersegmental regions equipped with stridulating mechanisms.

The sound-producing region may be divided into an anterior stridulating plate (Schrillplatte of Prell, 1913), a median region consisting of a rather transparent membrane, and a posterior file (Reibplatte of Prell, 1913). The relative position of these components can be seen on Plate II, Fig. 1, where the external parts of segments 5 and 6 have been separated to show the intersegmental region. In the normal infolded position, the stridulating plate or grating surface is directly opposed to the file with its numerous teeth. Sound is produced by the frictional mechanism of drawing the projecting teeth across the irregular surface of the plate. This "file" and "scraper" method of noise production is very common in insects and no doubt every external part of an insect body which is normally subject to friction on an adjoining surface may cause some sound.

It is assumed that the integument vibrates as each tooth in a file receives the impact of friction against the irregular surface of the scraper. The speed with which the surfaces contact as well as the resonance of the vibrating integument appear to effect the pitch of the sounds emitted. Rather complex modulated sounds result from these frictional devices in other insects, and we have some evidence, presented below, which indicates the complexity of the sound in the lycaenids.

The following observations call attention to similarities and differences in the stridulating devices of various species. These remarks are arranged by the major subdivisions of the sound-producing organ.

Stridulating Plate.

The stridulating plate is always just posterior to the sclerotized abdominal segment. Whereas the latter may have setae, microtrichia, and lenticels and otherwise be variously sculptured, the plate is usually rather uniform in structure. In fact, the regularity of the roughened surface of the stridulating plate may impart its distinctive nature and add to the impression that it is a band or "plate."

In many species the plate is heavily sclerotized. This hardening is usually indicated by the amount of pigment deposited in the integument. The rigid, exposed, anterior part of each abdominal segment serves as

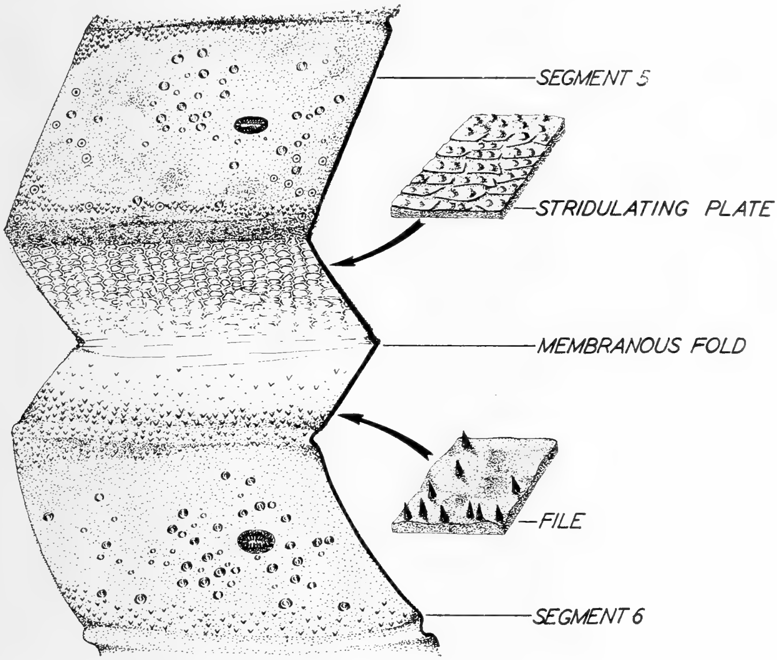

FIG. 1

FIG. 2

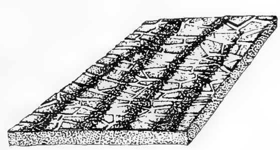

FIG. 3

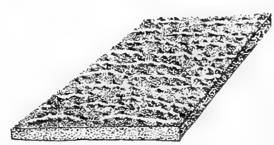

FIG. 4

Explanation of Plate 2

Partially diagrammatic drawings of the pupal integument showing stridulating organs. Fig. 1. Dorsal view of membrane 5 (see text) in the region of the spiracles in *Apodemia mormo virgulti* (Behr). Segments 5 and 6 have been separated so that the infolded stridulating plate and file are no longer in juxtaposition. Inserts represent enlargements of plate, showing tubercles on the grainy reticular surface, and the file with teeth and small protuberances. Figs. 2–4. Highly schematic enlargement of the stridulating plate; Fig. 2, *Strymonida spini* Schiff. with longitudinal ridges; fig. 3, *Atlides halesus* (Cram.) with reticular surface and sclerotized longitudinal bands; fig. 4, *Lysandra coridon* Poda with an irregular, aciculate surface.

a handy reference point for determining degrees of sclerotization in the stridulating plate. Ordinarily, the plate is not as heavily sclerotized as the segment. This is the case in most species of Plebejini, including *exilis* and *labradus*. On the other hand, the plate is often darker than the anterior part of the segment in species of Theclini, as well as *debora* and *coridon*. Or, the two areas may have about the same degree of sclerotization, as is the case in *halesus* and *jada*. Only the protuberances on the plate contain an appreciable amount of color in some species, so that the tubercles in *thoe* are the easiest means of delineating the plate. The anterior and posterior limits of the grating surfaces, which are not sclerotized, are usually indefinite.

As indicated above, the plate may extend completely around the segment in certain species, i.e., *evagorus, mormo, rossi,* and *wrighti*. In most species, however, the stridulating plate terminates laterally, at, or just beyond the stigmatal line. It may also end a substantial distance beyond this line (*acadica, beon, argus,* and *tarquinius*) or stop short of the spiracles (*adenostomatis, debora, genoveva, labradus,* and *marinus*). It was noticed that there was some intraspecific variation in the termination of the plate. One specimen of *henrici* had the dorsal grating surface end short of the stigmatal line, while the termination in at least six other specimens had a more typical terminus beyond the spiracles. This suggests a need for some caution in the taxonomic use of this character.

The anterior–posterior length of the stridulating plate, measured at the midline of the dorsal surface, was usually less than 0.15 millimeters. As might be expected, large pupae tended to have large plates, particularly in the Theclini. Correspondingly, one of the smallest pupae examined was *comyntas* whose plate measured 0.04 mm. An exception to this generalization was *Eumaeus*. Both *E. debora* and *E. minyas* have very large pupae, although the stridulating plates in both species were of only average length. The plate seemed to be the longest at the middorsal line, which at least in preserved material, was also the region of greatest possible movement. In species such as in the Riodininae where the plate completely encircled the pupa, there is less variation in length.

The type of grating surface on the stridulating plate is ordinarily distinctive and rather variable from species to species. Three basic types commonly observed are designated as 1) tubercles, 2) reticulations, and 3) ridges. A few surfaces did not fit any of these categories. These types are discussed below.

Tubercles are protuberances whose apices are not sufficiently sharp that they could be confused with teeth, nor sufficiently flat that they

could be mistaken for flat-topped plates. Generally tubercles are pimple-like structures varying in size from tiny ill-defined roughenings on an otherwise flat membrane, to rather large well-formed knobs. These roughenings are present in most species and often occur on other types of surfaces. It is almost impossible to assess the possible contribution tubercles might play in sound production when they occur in areas other than the stridulating plate. They can be noted on surfaces that normally do not contact other parts, as well as on intersegmental membranes other than those involved in sound production. The tubercles on the plate, however, are either sufficiently numerous, or large and clustered, in opposition to the file, that their part in stridulation appears more obvious.

Tubercles can best be observed where their structure is not obscured by pigments, ridges, or other sculpturing. Most Lycaenini have well-defined tubercles situated on a nonsclerotized reticulated surface (see below) which has a transverse orientation. This arrangement makes the tubercles also appear to be in obscure transverse rows. Both *phleas* and *thoe* exhibit this condition.

The tubercles may vary in density, size, or shape on a single specimen. Plate II, Fig. 1, illustrates the large knobby structure of the tubercles toward the anterior part of the plate in *mormo*. The opposite situation occurs in *beon* where small tubercles are located anteriorly, and large protuberances are posterior on the plate. Strawn (1964) measured the smaller tubercles in four different areas (anterior and posterior part of the plate in a mesal and lateral position) on nine species. Her figures indicate that while the average diameter of the base of the tubercles is greater toward the anterior area of the plate and toward the mesal area in the specimens examined, the size range of the tubercles (2–7 microns) was approximately the same for all areas from all species. Strawn also found interspecific variation in the number of tubercles per unit area. While this may be a real difference, attention has already been called to the variability in the clustering and number of tubercles in different areas on one plate, consequently extreme care must be taken to insure unbiased samples.

Cast pupal skins of 11 male and 14 female *thoe* were compared by Strawn (1964). She could not detect any differences between the sexes of *thoe* in regards to stridulating devices, particularly the average size of the tubercles.

Reticular surfaces on the stridulating plate consist of a series of prominences which, while actually subequal and irregular in size, are relatively uniformly arranged so that their longitudinal axes are roughly parallel. Thus the description applies not so much to a single protrusion as to a series of peaks and valleys whose surface texture can be com-

pared to grainy leather. This appearance is in large measure due to the net-like, interconnecting depressions between the prominences. In fact in some species, like *evagorus,* which lack tubercles on the prominences, it appears that the reticuliform valleys provide the functional grating surface. The reticular depressions may also impart a degree of flexibility on the surface, with the flection at right angles to the longitudinal axis of the grain. In most species with a pronounced reticular surface, the grain is transverse to the longitudinal axis of the pupa. Such a surface would appear to be more efficient as a grating device if the opposing file were drawn across the grain in the same direction as the body of the pupa.

The entire integument appears reticulate in *rossi,* yet in the region of the stridulating plate the prominences undergo anterior–posterior compression so that they are transversely elongate. Each elevation or "grain" in the plate has tubercles so that its surface is rougher and consequently much more distinct. Tuberculate grains are illustrated in *mormo* on Plate II, Fig. 1.

The nature of the plate surface in some species reinforces certain taxonomic conclusions made on adult specimens. The reticulate–tuberculate plate in *grunus* would seem to justify its placement in the separate subtribe (Thecliti) distinct from other Theclini (subtribe Strymoniti) as Clench has recently done (*in* Ehrlich and Ehrlich, 1961). The Strymoniti lack reticulations, and have distinctive longitudinal ridges.

Ridges on the stridulating plate are distinctive in having a rather pronounced crest with two or more sloping surfaces. Some ridges with numerous branching and anastomosing surfaces, as in *acaciae,* may be confused with those which are reticular. Usually, however, the valleys between ridges are very different in size and do not exhibit the general consistency of pattern that can be observed in the reticuliform types. Also, plates with ridges never appear to be flexible as do more granular surfaces. The ridges may have had their evolutionary origin in a reticular surface having been compressed in such a way that the integument folded vertically, with a subsequent obliteration of any reticular depressions along the axis of the fold. Regardless of origin, in most species with a pronounced series of ridges, the crests tend to run in the same direction as the longitudinal axis of the pupa. Thus oriented, they would appear to be more efficient as a grating surface if the teeth were drawn across them in a transverse direction, at right angles to the main axis of the crests.

As can be noted in the drawing of *spini,* Plate II, Fig. 2, the ridges form the only functional grating surface. They do not have tubercles or uneven areas other than those of the sides and crests of the ridges them-

selves. Other Strymoniti may have a few small roughened areas, but the strongly sclerotized longitudinal ridges of the plate characterize this group.

The stridulating plates of some species contain folds, which are not artifacts of slide preparation, whose relationship to the more prominent ridges with which they are grouped is not clear. In *beon*, for example, there are very regularly spaced tubercles which no doubt form the main frictional devices on the plate, but there are also very slight longitudinal folds. It would seem that such wrinkling of the surface, even though very slight, would tend to keep the teeth on the file away from tubercles in the valleys between the folds. Since the juxtaposition of plate and file in the living pupa is not known, speculation on the functional relationship between these folds and the tubercles is unwarranted.

As shown in Plate II, Fig. 3, *halesus* also has longitudinal sclerotized areas superimposed on a reticular surface which seems to be the functional area. The pupae of both *Eumaeus* examined, *minyas* and *debora*, are similarly unique because the ridges on the plate occur only on the lateral parts of the intersegmental region. Elsewhere, the surface may be sclerotized, but no tubercles, reticulations, or ridges can be observed and a distinct stridulating plate is lacking.

The stridulating surface of some species could not be grouped as consisting of tubercles, reticulations, or ridges. Plate II, Fig. 4, shows such a condition in *coridon*. The plate itself in *coridon* is heavily sclerotized, narrow and band-like in gross view. Its surface appears as if it were scratched and gouged with needles (aciculate), the resultant furrows have a transverse orientation. The prominences between the scratches cannot be properly designated as ridges or tubercles. The irregularity of the surface, however, makes it an excellent grater.

Membranous Region.

Between the stridulating plate and the file is a nonpigmented subdivision of the intersegmental membrane. This area is devoid of common structural features and for this reason appears transparent and much the same in all species. In its normal position the membranous region is folded so that the plate and file are in contact. In slide preparations it is extremely difficult to stretch the membrane flat; consequently, many fine transverse folds occur, which may give the impression that the surface is striated. It is to the lateral areas of the membranous region that longitudinal muscles and attachments are fixed in some species (see below). The remnants of such attachments are found in many cast pupal skins. The place of attachment of the muscles

prompted Prell (1913) to designate a "Prasegmentalleiste" in *quercus*, which he illustrated (1913: 498) as a series of transverse lines in the center of the membrane. I concur that the attachment of the muscles to this area indicates it is the region of primary intersegmental folding but feel that Prell's drawings make the area much more obvious than it is. No doubt the membrane and stridulating plate anterior to this primary fold belong to the anterior tergite, while the membrane and file posterior to the muscle attachment are derived from the adjacent posterior tergite. The only unusual feature is that the muscles appear not to be attached to heavily sclerotized plates but to a seemingly flexible conjunctiva.

The membranous area of cast pupal skins may contain artifacts such as adult scales and detritus, "accidentally" caught in the numerous folds.

File.

The posterior subdivision of the stridulating region is designated as the file. In most species it is not distinct except for conspicuous sharply pointed protuberances, or "teeth." The latter may have originally developed from smaller tubercles; a suggestive sequence of sclerotized tubercles grading into more elongate teeth is still retained in the Australian *hymetus*. Small tubercles also occur on files in other species such as *henrici*, but they probably do not play a part in sound production. Interspecific variation in characteristics of the teeth is often marked. The following conditions of the teeth were noticed with species or groups having the condition placed in parentheses: Sclerotized (*hymetus*), nonsclerotized (most species); small, indistinct (*comyntas*), large, well-defined (most Theclini); tendency for pairing (*hymetus*); irregular distribution (*mormo*, see Plate II, Fig. 1); tendency for clustering (*comyntas*), arranged in regular rows (*gryneus, acadica*); transverse rows of 4 to 5 (*exilis*); oblique rows (*fotis, sheridani, sylvanus*); and serpentine rows laterally (*johnsoni*).

Teeth are very common on other parts of the integument, particularly on the anterior margin of each segment. Most often these teeth do not appear in a position where they would contact another surface. However, they do occur on posterior parts of the intersegmental membranes, in a position corresponding to the file on the sound-producing membrane. Although they are not opposed by obvious surfaces like the stridulating plate, it is possible that the teeth in other movable intersegmental areas also contribute some sound when they are rubbed against the integument.

The anterior–posterior length of the file is very difficult to measure

because of the irregular placement of teeth and tubercles. In general it can be said that the length of the file is smaller than the length of its corresponding plate. The file, however, always extends further laterally than the plate, except in those species where both structures encircle the pupa.

A few species have files which were considered less typical than others. For example, while the teeth of *adenostomatis* did not differ from those of other Theclini, the region of the file was very obvious as a sclerotized band. The file of *tarquinius* lacks teeth and consists only of irregular nonsclerotized tubercles. Although equipped with small teeth and sclerotized tubercles, the file of *labradus* has a slightly granular surface.

Movements Associated with Sound.

As mentioned earlier, the file and stridulating plate are brought into contact by rapid dorsoventral movements of the abdomen. Since the stridulating plate *in situ* is not perpendicular to the body axis but projects caudoventrally from the tergite, the direction of the stridulating movements might be more accurately described as a cephalodorsal drawing of the file across the stridulating plate. Since the file and plate also arch with the segments from one lateral surface to the other over the rounded dorsum, the angle of movement of the teeth across the grating surface is slightly different from area to area.

Movement is made possible through contraction of longitudinal muscles in the dorsal abdominal region which, according to Prell (1913), attach to the "Prasegmentalleiste" on the intersegmental membrane in *quercus*. Contraction causes the file to slip forward over the plate. Strawn (1964) found a pair of longitudinal muscle bands attached to the intersegmental region in *thoe, debora,* and *henrici,* although the insertion in these species was lateral in position. I have been able to trace the muscle bands thought to be involved in *sheridani* pupae, from an origin on the anterior margin of tergite 3 to their insertion on the posterior intersegmental membrane between tergites 5 and 6. The latter insertion appeared to be as much on the anterior margin of segment 6 as on the membrane itself, which would agree with the muscle attachment concept in primary segmentation (see Snodgrass, 1935). Each of the two muscle bands was about one millimeter wide and located on the lateral surface midway between the spiracular line and the midline. These muscles were found, in segments of the adult (see below), and a short ligament connected the adult integument with the pupal fifth intersegmental membrane. Strawn (1964) found these ligaments, which she called stridulating attachments, in sectioned pupae,

but they are also visible with ordinary dissecting procedures. We were not able to locate scars or rudiments of the ligament on adults, even freshly emerged specimens.

We did not locate any muscles which seem to work antagonistically to the longitudinal pair, and therefore assume that the elastic nature of the pupal integument, or fluid pressure in the adult body, may return the file to a "resting" position where it is not in contact with the plate.

There is some question as to which stage of the life cycle is involved in these movements. Snodgrass (1935: 64) points out that whereas the length of a developmental stage may be measured from the time exuviae are shed, as is done in "life history" studies, physiologically it should be calculated from the time the old cuticula is loosened from the epidermis. Hinton (1946) likewise points out that the precise discrimination of instars is of considerable importance, particularly when dealing with the imaginal stage. Hinton proposes the name "pharate" (= cloak) to designate the phase of an instar which is enclosed within the cuticle of the previous instar and considers that, for instance, most records of "hibernating" pupae are pharate adults. It has been regarded as axiomatic, particularly by many students of Lepidoptera, that adult life commences with its emergence from the pupal case. In spite of certain objections (see Tutt, 1900), there is some justification for the belief that many individuals ordinarily called pupae are in reality pharate adults, and that adult life in butterflies may have two stages, a pharate stage and a stage capable of flight. In certain cases the onset of the pharate adult stage may coincide with the elaboration of a pupal case; it may also occur at a much later time, perhaps after an extended diapause.

Thus considered, the stridulating response in Lycaenidae, and the movements responsible, may be limited to pharate adult behavior. The real pupal stage would then have to be considered as occurring during that brief quiescent period ordinarily thought of as a "pre-pupal" interval. The real pupa may be capable of some limited movements owing to the fact that some abdominal muscles are carried over from the larvae. Most "pupal" movements, however, seem to be those of the pharate adult. It perhaps matters little whether we call this stage a physiological adult or a pupa as long as it is understood that the muscles and the instigating sensory apparatus are still present in the emerged adult while the stridulatory devices seem to be limited to the pupal integument. It may also be of significance in the function of sound that it is limited to this particular stage, regardless of name. To prevent confusion in subsequent discussion, the term pupa will

still be used in the broad sense in referring to the stage which is surrounded by a pupal skin containing the stridulating organ.

Sounds Produced.

The sound of 12 Nearctic and 1 Neotropical species detected during this study could all be described as slight, rapidly repeated, creaking noises. A squeaking door analogy might be used for comparison, provided we lessen the amplitude of the noise and move the door with a series of short pulls rather than a steady motion. As indicated above, we often had difficulty hearing the noise unless the pupae were contained in a sound reflecting device such as a vial. On the other hand, in some species, such as *thoe,* the sounds were sufficiently loud so that at least two types of noises could be detected; a distinct chirp and a slight humming noise. It is thought that noises of the former type are produced by the stridulating devices, while the latter type may be caused by other as yet undetected movements of the integument.

With some difficulty, we were able to tape-record the sounds of Illinois *thoe* and *henrici.* Strawn (1964) was able to feed these tape outputs into an oscilloscope and obtain a graphic representation of the sounds produced. There were differences in both the intensity and frequency of the noises of the two species, which helps verify the slight differences between species noted by the unaided human ear. At least one other author noted interspecific differences in the sounds: Dodd (in Bethune-Baker, 1905) reported that although *Ogyris oraetes* Hew. and *O. hewitsoni* Waterh. produced the same "tick" as *O. zosine* Hew., the ticks were not as frequent or as loud.

Sound was detected at various times throughout the pupal period in several species, including *phleas, thoe, gryneus, henrici, melinus,* and *comyntas.* In *thoe* the earliest sound detected was within minutes after the last larval skin was shed. An individual of the same species was also heard to stridulate up to the time of eclosion of the adult. In almost all cases the sound was elicited by external agitation, usually by shaking or finger-thumping a vial containing the pupa. Only occasionally were we able to detect spontaneous stridulation. The infrequency of this observation was due in part to technical difficulties in the elimination of other possible stimuli as well as in detecting the noise proper.

Many times pupae would not respond to agitation of any sort. No doubt excessive application of unnatural stimuli failed to trigger the responses in certain individuals and particularly at certain times. For example, individuals of *henrici,* which overwinter as pupae, would tend to have normal stridulating responses both early and late in the pupal period. They stridulated only infrequently and unpredictably during the

middle five months of their diapause. After accumulating some experience with each species, we were able to use sound as an index of pupal viability. Since individuals reacted differently to the same stimulation, and since this reaction also varied with the time of the pupal period, additional studies are warranted.

Origin of Organs.

It is thought that the origin of structures used in stridulation in the pupa is intimately associated with abdominal movements. This opinion rests primarily on the frequent existence and morphological similarity of a grainy reticular surface in Lepidoptera with highly flexible abdomens. The need for abdominal movement is apparent in certain moth groups; some species can only emerge from cocoons, or from rigid pupal cases, by vermian climbing or pushing from the container. Frequently nearly the entire pupa pushes through the cocoon prior to adult eclosion. Since these groups exhibit a number of other features considered to be primitive, abdominal flexion may be ancestral in the order (for a discussion see Tutt, 1900, and Mosher, 1916). Obtect butterfly pupae have become relatively more rigid and have lost all motion of abdominal segments except in membranes 4, 5, and 6. The Lycaenidae are considered to have very advanced forms of obtect pupae supposedly because of even greater loss of motion. However, not all motion is lost in these seemingly rigid pupae, and retention of some flexibility, at least in the dorsal part of membrane 5, is a reflection of functional need. That need in this family may also be, as in the primitive moths, for physical adjustments necessary for adult eclosion. This may still be the main physiological explanation for the retention, irrespective of the fact that the movement is small and that any sound produced may have proved advantageous to the species.

Butterflies and moths with obtect pupae almost invariably have some sort of partially sclerotized flexible surface on any movable abdominal segment. This surface is usually located between the more rigid sclerite and the infolded membranous cuticle. These areas have surfaces which are plastic enough to flex but still retain almost the same degree of sclerotization as the rigid part of the segment and hence have the same degree of protection which their external exposure might require. This surface is beautifully illustrated in the grainy reticular posterior margins of abdominal segments 4, 5, and 6, and to a lesser extent 7, in the moth *Callosamia promethea* Drury. Pupae of the butterfly *Junonia evarete* (Cram.) also have granular flexible areas between a few of the abdominal segments. In such species as *Citheronia regalis* Fabr., the flexible part of the segment has fine transverse striae, rather than a

granular network. The anterior margin of individual segments in many species likewise becomes variously ridged, grooved, tuberculate, or dentate and may become rather flexible, though this is not as marked as in the posterior margin. Both margins usually appear slightly less sclerotized than the middle of the segment. It would seem that when abdominal movement is extensive in a pupa, some sort of flexible strip of granular texture occurs between the rigid annulations and the flexible conjunctivae on each movable segment.

It can thus be theorized that as pupae of the ancestral proto-lycaenid became more rigid, need for any flexible granular margins on abdominal segments was also reduced, and these structures gradually disappeared. Probably they were first lost between those segments which became completely fused (7 and 8, then 4 and 5). In partially fused segments, a protective advantage would be retained longer, thus the flexible granular surfaces would persist near their juncture with the rigid part of the segment. Intersegmental movement appears to be lost first ventrally, so that between partially fused segments, the flexible surface might have been retained only in the dorsal regions. It is thought that the stridulating organs, particularly the very similar plate, are remnants of this flexible sclerotized band. They are still retained dorsally in most lycaenids in the most flexible intersegmental area. In groups such as the riodinidae with longer and more flexible abdomens, the stridulating organs encircled the body and are still preserved on other movable intersegmental areas.

Taxonomic Considerations.

Although it has been indicated that stridulatory structures have possible taxonomic use, it is not the purpose of this paper to discuss higher taxa within the Lycaenidae. Rather, it is intended to point out that, in addition to their use in identifying species, the structures seem to have a value in reflecting group relationships. One example might suffice. Ehrlich (1957, 1958) lowered the Riodinidae to subfamilial rank within the Lycaenidae on the basis of adult morphology. Not all authors agree with this assignment (see Garth and Tilden, 1963). We have been unable to locate stridulating devices in the pupae of several Nearctic species of Papilionidae, Pieridae, and Nymphalidae examined. The riodinids, however, not only have the structures, but they are definitely of similar type to those found in other lycaenids. We think these organs reflect common origin and can be used to strengthen the taxonomic relationships proposed by Ehrlich.

It may be noted in Table I that stridulation has been reported in species from all six major biogeographical regions. Summarized by

number of species reported as sound producers, these are: Nearctic 41, Neotropical 3, Australian 10, Oriental 10, Palearctic 12, Ethiopian 5. The worldwide distribution of this behavior, as well as the taxonomic diversity of the species involved, suggests that the Lycaenidae have been capable of sound production for a long time.

Function of Sound

The major emphasis in this study has been morphological, with relatively little effort directed toward the difficult task of discovering the possible function of sound. Nonetheless, knowledge of the biology of the lycaenids involved, together with some generalizations on the morphological aspects, permit some implications to be drawn. It should be understood, however, that the function of the sounds is not known, and the following explanations are speculative.

Prell (1913) suggested two possible functions for sound in pupae; for defense and to congregate larvae. The same author (1913: 500) noted that the "weakness" of the sound might negate the former function. Since gregarious associations of prepupal larvae or pupae are relatively rare in the family and since sound receptors have never been detected in the larvae, it seems that the concept of a "congregating" function to pupal sound is not as tenable.

Hinton (1948) presents an excellent discussion of possible functions of pupal sound and states that it is primarily defensive. He arrived at this conclusion by eliminating sound as being involved with social or sexual behavior, with emergence of the adult, or with slight adjustments to temperature or humidity that a small proportion of sound-producing pupae may be able to make. Hinton notes that the defensive function, though unsupported by direct evidence, is strengthened by the fact that the pupae, as a rule, only stridulate when they are disturbed.

Haskell (1961) and Wynter-Blyth (1957) also believe that the defensive function is the most plausible of those suggested. Further corroborating the defensive function, Carter (1952) reported that stridulation in *Strymonidia w-album* Knoch is loud enough to deter a predacious bird. However, in a paper by Cole (1959) devoted exclusively to the defensive mechanisms of lepidopterous pupae against Ichneumonidae, sound was not mentioned.

An added complication in considering the defensive function is the fact that the larval stage is subject to more parasitism and predation than the pupal stage. Not only are more parasite species involved with larval stages, but most of the parasites, such as Tachinidae, Ichneumonidae, and Braconidae which emerge from the pupa, result from early stages in the butterfly larvae. Should sound production be an excellent

defensive mechanism, one would be hard pressed to explain its almost universal occurrence in lycaenid pupae and its almost universal absence in larvae. Perhaps the increased parasitism is only an aftermath of the greater availability of larvae or a physiological necessity of the parasite; I seriously doubt that the compartively low rate of pupal parasitism is due solely to protection afforded by sound. In this connection, however, it should be mentioned that Dodd (1916) reported that large lycaenid larvae in Australia *were* capable of sound production when "bunched up for moulting." We have thus far been unable to detect noise in Nearctic larvae nor have we located any structures which could produce such noise.

It may be a mistake to look for single over-riding functional reasons for sound production. Consequently, other possible functions not discussed by earlier writers should be suggested as an aid and guideline for future research in this area. Contrary to Hinton's opinion that the noise does not play a part in sexual behavior, it may be that pupal sound attracts adult insects to the vicinity of pupal niches so that mating can occur immediately after emergence of the adult. In many species females mate soon after emergence. This function need not be universal, so that we might not expect such a function in pupae which are deep within the ground where sound could not reach the surface. The point to be made here is that we cannot completely dismiss the "adult-attracting" function even though it is weakened by the following facts: the slightness of sounds produced, lack of knowledge of adult sound receptors, equality of sound in both sexes, sound production both early and late in the pupal period, and optical rather than acoustical stimuli seeming to be the key release mechanism in initiating mating responses.

Another possibility is that stridulation is only secondary to the movements responsible for it, and the movements themselves may be a metabolic necessity. Certainly the external contact of parts of an insect's body when it is moving, depending on the degree of friction, can produce some sound. So little is known of the physiological activity during the pupal stages, however, that further discussion on metabolic need for movement is fruitless. We have earlier mentioned that physical need for movement during eclosion is apparent in certain nonlycanenid species.

Implied above in the suggestion that sound might be only an aftermath of movement, is the fact that there need not be a function. That is to say, the sound may be only incidentally and accidentally produced. Of course very little is known about ultrasonics, and only those sounds are studied which fall within the human auditory range, and only those which are sufficiently loud to attract attention. It is of interest that almost every insect which is studied for possible sound is found to

produce noise. Perhaps there are many other sounds produced which we do not hear. As techniques and equipment for recording and measuring ultrasonic sounds becomes perfected, no doubt explanations of function of sound will also increase. However, we cannot dismiss the fact that there may be no direct function. The occurrence of sound in such divergent taxonomic groups, however, together with the definitive organs involved, weakens the explanation based on accident.

Another suggested explanation for the function of pupal sound in the Lycaenidae is involved with their symbiotic relationship with ants. Larvae of most Lycaenidae are tended by ants for the secretions from exudate glands of the larvae. These glands, particularly those on the seventh abdominal segment, may remain functional in the pupa, which may likewise be tended by ants. The evolution of this association between ants and the immature stages of lycaenids is reviewed in part by Balduf (1938, 1939) and Hinton (1951) and has been noted by me in several western Nearctic species. It will be worthwhile to consider briefly some aspects of this relationship.

Immature individuals of the lycaenids are thought to derive some benefits from the ants. These benefits are easily observed in some species, somewhat more subtle in others, and unknown for certain species. Among the most obvious advantages to certain butterfly immatures include: protection from predators and parasites, a means of transportation for food (from plant-to-plant) or shelter (plant-to-ant nest or to special resting chambers), and internidal development and care (feeding by regurgitation). The divergence of behavioral patterns, the great number of ant and lycaenid species involved, and the wide geographical occurrence of the relationship, suggest that the two types of insects have been associated for a long time.

The function of the exudate gland would seem to be obvious in the myrmecophily, but many species which possess the glands have never been reported with ants. Other species are known where the glands are restricted to positions other than abdominal segment seven, or, as in the genus *Lycaena*, they may be scattered over the body. In some species the glands are not evident, but the larvae are still attended by ants. All of these conditions have been explained on a presumed phylogenetic basis. That is, occurrence of the gland and the myrmecophilous relation is thought to be ancestral. Loss of the gland in certain genera, or extremes in the relationship with ants (from complete internidal development to no association) are considered to have been independently acquired.

The development of zoophagous feeding habits is thought to have been intimately associated both with the propensity for lycaenid species

to be cannibalistic, and their intimate relations with ants. In fact, several species which are phytophagous during their early instars become predacious during their last larval stage, feeding on ant young. The adult ants transport the mature lycaenid larvae to the nest and not only tolerate zoophagy by their guests, but actually may feed their own young to the butterfly larvae. It is only a short evolutionary step from this intermediate feeding habit to the completely predacious existence. It should be noted that the zoophagous feeders in this family are either on ants, aphids, scales, jassids, or membracids with which ants are intimately associated.

Let us now consider a few additional observations on sound which may be pertinent. Bethune-Baker (1905) was informed by Dodd that three species of the Australian genus *Ogyris* would emit sounds in the pupal state only in the presence of ants. If the ants were taken away, the pupae remained silent. Dodd also stated that if the pupae were not attended by ants, it was an almost certain indication that they were dead. Wheeler (1913: 512) says that *ants also stridulate.* Sound-making ability has been noted in many ant subfamilies and has been known since 1878 (Swinton, 1878–1879). Wheeler (1913: 513) notes that stridulation is an important means of communication among ants. More recent studies on ant communication have not verified the importance of sound but have disclosed the widespread use of chemical communication by means of pheromones (see Wilson, 1963). While not wanting to deemphasize the implications of the chemical vocabulary in ants presently being analyzed, it seems likely that other sensory mechanisms are also concurrently involved. These include visual, tactile, and auditory signals, and the latter warrant attention here.

It is possible that noises produced by lycaenid pupae advertise their presence to ants. Originally this ability may have developed in the pupa together with a functional exudate gland, in which case noise may not only have helped attract ants, but served to excite them into feeding activity. Lycaenid larvae are also equipped with eversible tentacles whose function has been debated (see Downey, 1962) but which may be to attract and excite ants by production of pheromones. Since these tentacles are not functional in the pupal stages, even when exudate glands are present, it is possible that stridulating devices assume attractant function in the pupa. It should not be difficult to design an experiment to show whether audible and ultarsonic sounds produced by the pupa attract and stimulate or repel the ants. A comparison of sounds produced by ant and pupa would likewise prove interesting, particularly where the associations are rather specific.

Moreover, we can conceive that, much like the exudate gland and the

myrmecophilous condition in general, ability to stridulate has been retained in pupae of many different taxonomic groups within the family. Perhaps its retention in some groups has been on the basis of a secondarily derived benefit, particularly in those species which no longer have exudate glands, or like *tarquinius,* are not tolerated by ants. This advantage could be protection afforded the pupa by stridulation, which character would perhaps have been reinforced as ancestral pupal types lost the protection afforded them by ants. Thus, the presumed defensive function of pupal sound need not be discarded, but can be strengthened.

Some information on function may be obtained from the species which appear to lack stridulatory devices. One such species, *Glaucopsyche lygdamus* (Dbldy.), is strongly myrmecophilous; the larvae are tended by at least three species of ants (Downey, 1965), and it is the only Nearctic species reported with an internidal pupal stage (Tilden, 1947) and with functional pupal exudate glands (Downey, 1965). One would assume that if stridulation was involved in the symbiotic relationship of pupa and ants, *lygdamus* would have a superior noise apparatus. Instead, it is one of the very few which lack these devices. Conversely, the carnivorous *Feniseca tarquinius,* whose larvae prey on aphids and are subject to attacks by aphid-tending ants, retains stridulatory organs in the pupa. Also as indicated above, there is evidence that the ant-feeding *Liphyra brassolis* Westw., which is viciously attacked by the tree ants in whose nest it lives, also has noise making devices in the pupa, even though Dodd (1916) claimed this species did not make sounds. Dodd has been the only author to express the opinion that pupal movements and sounds were necessary in the symbiotic relationship of ants and larvae.

If one assumes an "ant-attracting" function for the organs, at least in origin, some attempt should be made to explain retention of stridulation in species which ants do not tolerate. Most lycaenids of this type are internidal, and thus not exposed to regular predators and parasites. In this case even a protective function to the noise is not tenable since it does not deter the ants, nor is it necessary for other animals in this niche. The stridulatory structures may have been retained here due to pleiotropy; a genetic tie with other needed characters.

In analyzing the function of sound and its origin in this family I speculate as follows: stridulatory organs and associated structures, such as muscles involved in moving the devices, are considered ancestral characters present in the protolycaenid stock. They developed from structures originally involved in abdominal flexion and adult eclosion. The noise produced then became increasingly more functional and ad-

vantageous to the pupa either in a myrmecophilous relationship, or in protection from parasites or predators, or both. These assumptions are presently being tested.

Summary

1. Pupae of 81 species (38 genera) of the family Lycaenidae (*sensu lato*, including Riodinidae *auct.*) have the ability to make noise: six species "hammer" their bodies against the substrate; 75 possess stridulatory organs.

2. Pupae of three species (two genera) of the family lack the stridulatory organs and presumably are unable to make noise.

3. Pupae of certain moths and some butterflies belonging to other families, including the common Monarch, are capable of sound production, so that this feature is not unique to the Lycaenidae.

4. The stridulatory organs in various lycaenid pupae are located on the same structures, and have a basic morphological similarity, which suggests common origin.

5. Three main parts of the sound-producing structure include a stridulating plate, a membranous region, and a file. The latter bears teeth and other protuberances which rasp against the anterior plate. Three types of surfaces are recognized on the plate: tuberculate, reticular, and ridged.

6. There is some question as to the physiological stage of the life cycle here involved. The "pupa" might be considered a pharate adult. However, the muscles and sensory apparatus involved in sound production are still present in an emerged adult, while the stridulating devices proper seem limited to the pupal integument. Sound also seems to be limited to this particular stage of development regardless of name.

7. The organs may have originated from grainy reticular surfaces associated with flexible abdominal segments. As obtect pupae lost their motility, these surfaces were retained only in the movable segments. In the rigid pupa of many Lycaenidae, some flexion has persisted in certain abdominal segments, perhaps retained only because of its necessity in sound production.

8. Of the many possible functions of sound in the Lycaenidae, two seem most plausible: a defensive mechanism and an auditory signal for associated symbiotic ants.

9. The stridulatory organs have many characters of possible taxonomic use. The worldwide distribution of the characters, as well as the taxonomic diversity of the adults involved, suggests that sound production is both universal and ancestral in the family. Species which have lost the structures, retain modified structures, or have lost the presumed basic functions, have acquired these traits secondarily.

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NOTES ON W. H. EDWARDS SPECIMENS IN TWO MIDWESTERN COLLECTIONS

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INTRODUCTION

Early in 1947, while studying some butterflies received from my friend Murray O. Glenn, of Henry, Illinois, my attention was attracted to a specimen of *Phyciodes texana* (Edw.) which bore a label reading "E. cincta ♂/bred Oct. 78." Recalling Holland's discussion of the name *cincta* (1931), I wrote Dr. W. R. Sweadner of the Carnegie Museum regarding this specimen, and although I had no reason to suppose there was anything unusual about the label other than the name in question, I sent it to Sweadner. He replied stating that he had compared it with holograph labels of W. H. Edwards in that institution, and that he believed it to be in the handwriting of Edwards. He suggested that I publish a note regarding the discovery of the specimen, tracing its history if possible. This, however, I did not do, although I found among the butterflies received from Glenn a considerable number of others bearing labels in the same handwriting.

In the spring of 1963 I again became interested in the Edwards specimens as a result of learning of F. Martin Brown's studies of the type material of Edwards, and I resolved to carry out the late Dr. Sweadner's suggestion, which had been so long deferred. I forwarded all of the Edwards specimens in my possession to the Carnegie Museum, where Brown examined them and pronounced them genuine. He reiterated the opinion that an account of their discovery was worthy of publication. Thus encouraged, I proceeded to attempt to trace the steps whereby these specimens had reached the collection of Glenn. Meanwhile, further examination of the latter's collection resulted in the finding of still more Edwards specimens, which Glenn, with his characteristic generosity, turned over to me in view of my interest in their historical importance. These subsequent specimens were also examined by Brown.

It is the purpose of this paper, not to advance any opinion upon possible taxonomic significance of these specimens, but merely to call attention to their existence and present location; and incidentally to present an interesting bit of entomological history, as well as brief and previously unpublished biographical sketches of two Illinois amateur collectors of an earlier day.

History of the Edwards specimens

The specimens discussed in the present paper were sent by Edwards to Augustus H. Mundt, of Fairbury, Illinois. Mundt was born in Germany in 1847 and came to the United States during the first year of the Civil War. Two years later, he enlisted in the 11th Illinois Cavalry. Late in 1864, he was wounded in the foot and taken prisoner. His wound troubled him greatly for the rest of his life. He came to Fairbury in 1868, and operated a jewelry business there for 62 years. He was an enthusiastic amateur butterfly collector, and in addition was interested in such diverse fields of natural history as conchology, oölogy, and taxidermy, as well as in the formation of a collection of Indian relics. According to his son William, of Sullivan, Illinois, he was a personal friend of Dr. L. O. Howard.

Mundt was interested in the rearing of Lepidoptera. He contributed several short articles to *The Canadian Entomologist* and *Papilio*, which are listed in the references, and which have largely to do with immature stages and rearing techniques. It may have been this interest which led to his correspondence with Edwards, for in a letter to Edwards dated May 21, 1884, Mundt speaks of sending him a box containing some prickly ash, with detailed instructions as to planting and caring for it. Possibly it was in exchange for material such as this that Edwards sent butterflies to Mundt, but at least some of them were purchased, as will be shown later.

In later life Mundt's interest in butterflies appears to have diminished to the extent that by 1923 he was considering the sale of his collection to Judge R. M. Barnes, of Lacon, Illinois. Richard Magoon Barnes (1862–1945) was a distinguished lawyer and judge, and apparently was not related to Dr. William Barnes of Decatur, Illinois, who is more well known to Lepidopterists. Like Mundt, Judge Barnes was interested in many areas of natural history and in collections illustrative of them; but his specialty was North American birds' eggs, of which he built up an extensive collection, a large part of which is now in the Chicago Natural History Museum. Barnes served there at one time as curator of oölogy, and he was editor and publisher of *The Oölogist* for a number of years. His collections, embracing a nearly complete representation of the mammals, reptiles, and birds, and many of the insects of Illinois, were housed in a specially constructed museum adjacent to his home. His collection of Lepidoptera was worldwide in scope and was built up over a period of some twenty-five years by personal collecting in the field as well as through purchase and exchange.

A number of letters exchanged between Mundt and Barnes during

1923–1925 are in my hands. They give us an insight into the work of Mundt during the period of his active interest in Lepidoptera. In an effort to justify his asking price of five hundred dollars for his collection and cabinet, which Barnes apparently thought unreasonably high, Mundt enumerated some of the amounts that he had invested in it. In a letter to Barnes dated November 28, 1923 he says, "I paid . . . from $100 to $150.00 to Oscar T. Barron [sic] of California through W. H. Edwards for many of his specimens . . ."

In other letters he speaks of his dealings with Herman Strecker, which were apparently unsatisfactory. Mundt learned that schoolchildren in Utah were being paid to collect and destroy cocoons of *Platysamia gloveri*, as the larvae were believed responsible for widespread defoliation of plants. He offered more money to have the cocoons sent to him instead of being destroyed, so that he was soon receiving three or four boxes of cocoons a day, which he advertised for sale at $1.50 per dozen through notices in *The Canadian Entomologist* and *Papilio*. In another letter to Barnes on December 18, 1923, he complains that "The fact is that Strecker did not treat me right . . . he ordered a number of dozens but never paid me cent for them making all sorts of excuses so at last I told him to send the Supplements [to Strecker's *Lepidoptera, Rhopaloceres and Heteroceres, Indigenous and Exotic*] . . . but never came through. I wrote him several times about them and when he died his wife wrote that as he had spent over $15,000 on his collection she was obliged to sell it at a great sacrifice. . . ."

Although Barnes replied to these letters saying that "my experience with collections, which has probably been greater than that of any other in America, is that there is a limited market for collections unless they are exceedingly large and the property of some well-known author in the scientific line to which the collections pertain," still he says the following year that ". . . I always had the modest collection of Butterflies and Insects which you showed me in mind and I hope someday to be able to add them to my collection here." Eventually he did, but it must not have been until considerably later, as one of the Edwards specimens is labeled, "From A. H. Mundt collection December 1936 R. M. Barnes." Mundt died January 1, 1938 at the age of ninety.

Following the death of Barnes seven years later, his collection was broken up. The greater portion of the Lepidoptera went to the Illinois State Museum at Springfield, where it remains. A representative series of Illinois butterflies and moths was deposited in the collection of the Illinois Natural History Survey at Urbana, while Glenn, who had been a personal friend of Judge Barnes, also received a portion of his collection.

I examined the collections of both the above-mentioned institutions in a search for further Edwards specimens. None were found among the Barnes material in the Illinois Natural History Survey collection, probably because of the preferential selection of Illinois species that had been made. However, several specimens bearing labels in the handwriting of Edwards were found which apparently came from the collection of Selim H. Peabody. While a discussion of these is beyond the scope of the present article, they may form the subject of a future note. At the Illinois State Museum 23 more Edwards specimens were found, which with the 63 from the Glenn collection made a total of 86 discovered as a result of this investigation, exclusive of the Peabody material. Through the courtesy of Dr. Rupert Wenzel of the Chicago Natural History Museum, the 63 from Glenn's collection have been deposited there for safekeeping, although they remain a part of my collection and are so labelled. To all these, as well as to those in the State Museum, I have attached printed labels on yellow paper reading "From/W. H. Edwards."

When the material first came into my possession, I attached typewritten labels on blue paper reading "Metatype" to all those which represented Edwards' own names. Although these were for my own convenience and have no standing, I have not removed them unless more formal designation has since been made.

In listing the individual specimens discussed herein, I give first the name of the species using current nomenclature, for the most part following dos Passos (1964). Next I quote the exact wording of Edwards' holograph label, followed by the text of any other labels that may be present other than those which I have applied as indicated above. Finally, I append any pertinent remarks, as well as symbols indicating their present location, in my own collection (RRI) at the Chicago Natural History Museum, or in the collection of the Illinois State Museum (ISM).

Little of the material has thus far been the subject of critical study, either by myself or by specialists, for the purpose of confirming Edwards' determinations. Where this has been done, the fact will be evident from subsequent labels. A relatively few distinctive species, such as *Limenitis wiedemeyerii*, are incapable of confusion with any other. For the rest, I have been obliged to use Edwards' names for the purpose of this paper, since to have examined all of them would have delayed its preparation still further, while I think it desirable that it appear contemporaneously with Brown's studies. I am grateful to the latter for the information regarding Edwards' probable source of the various specimens.

Among the more frequently recurring abbreviations on Edwards' holograph labels which are not self-explanatory are: "W.T." for Washington Territory; "M." or "Morr." for H. K. Morrison, and "O.B." for Oscar T. Baron. Other abbreviations are explained where they appear.

LIST OF THE EDWARDS SPECIMENS

Hesperiidae

Ochlodes sylvanoides (Bdv.) "Agricola ♂ / W.T. M." "Ochlodes / sylvanoides / ♂ (Bdv.) / Det. J.W. Tilden" (RRI); another with identical labelling except for the omission of a sex sign on Edwards' label (RRI); "Agricola ♀" "Ochlodes / sylvanoides / ♀ (Bdv.) / Det. J.W. Tilden" (RRI).

Ochlodes agricola (Bdv.) "Agricola ♂ / Nev[a] Mor." "Ochlodes / agricola / ♂ (Bdv.) / Det. J.W. Tilden" (RRI). From Nevada.

Atalopedes campestris (Bdv.) "Huron / ♂ Kan[a]." (ISM). Kanawha County, West Virginia, probably taken by Edwards near his home in Coalburg.

Wallengrenia otho egeremet (Scud.) "Egeremet ♂ / Kan[a]." (RRI). Same source as the preceding specimen.

Hesperia harpalus (Edw.) "Comma ♂ / v. sylvanoides / Cal." "Hesperia / harpalus / (Edw.) / Prob. a coast range pop. / Det. J.W. Tilden" (RRI); another with similar labelling except that no locality is given on Edwards' label (RRI). A third specimen has no Edwards holograph label, the only one discussed in this paper which is so lacking; yet from the text of the following label in the handwriting of Mundt it is believed to be from Edwards: "Pamphila which I / believe to be sylvanoides / of Boisdvl / W.H. Edwards" (RRI). It bears Tilden's determination label similar in wording to the others.

Erynnis propertius (Scud. & Burg.) "Propertius" (ISM); "Propertius / Scudd.-Burg." "Sonoma Co. / California" (RRI). The latter label has the word "Sonoma Co." in the handwriting of Henry Edwards; the second line is printed.

Riodinidae

Apodemia mormo (Felder) "L. cythera ♂" "Apodemia / mormo / ♂ (Feld.) / det. R.R. Irwin" (RRI).

Lephelisca virginiensis (Guérin-Méneville) "Caenius / ♂ Ga." (RRI).

Lycaenidae

Hypaurotis crysalus (Edw.) "Thecla / crysalus ♂ / Colorado" (RRI).

Callipsyche behrii (Edw.) "Behrii ♂ / Nev. Morr." (RRI); "Behrii ♀ / Nev[a]." (RRI).

Incisalia iroides (Bdv.) "Iroides ♀ / Nev. Morr." (RRI).

Incisalia eryphon (Bdv.) "Eryphon ♀ / Cal[a]." (RRI).

Strymon melinus franki Field. "Melinus / ♂ Col." "Strymon / melinus franki / ♂ Field / Det. F.M. Brown." (RRI).

Strymon adenostomatis (Hy. Edw.) "Adenostomatis ♂ / Cal. O.B." (ISM); "Adenostomatis ♀ / Cal. O.B." (RRI); "Adenostomatis ♀ / Nevada" (ISM).

Strymon saepium (Bdv.) "Saepium ♂ / Cal." "222" "Havilah / California" (partly printed; RRI). Probably from Richard Stretch through Henry Edwards. The label "222" is a manuscript number of the latter, and the word "Havilah" is in his handwriting. A second specimen is labelled: "Saepium ♀ / W.T. M." (RRI).

Callophrys sp. undetermined. "Dumetorum / Cal." "Callophrys / sp. possibly / *viridis* Edw. but / antennae needed for / positive identification / J.W. Tilden" (RRI). Possibly from Herman Behr.

Lycaena gorgon (Bdv.) "Gorgon ♀ / Cal." (ISM).

Lycaena xanthoides (Bdv.) "Xanthoides ♂ / Cal^a." (RRI); "Xanthoides ♀ / Cal^a." (ISM).

Lycaena rubidus sirius (Edw.) "Sirius / ♂ Colo." (RRI); "Sirius ♀ / Colo." (RRI).

Lycaena nivalis (Bdv.) "87 zeroe ♂" (RRI); "zeroe ♂" (RRI). Both are additionally labelled "Lycaena / nivalis / ♂ (Bdv.) / Det. R.R. Irwin." For a discussion of Edwards' use of the name *zeroe* in this connection, see Brown, Eff, and Rotger (1955) p. 158.

Lycaena helloides (Bdv.) "Helloides ♂ / W.T. M." (RRI); "Helloides ♀ / W.T. M." (RRI).

Brephidium exilis (Bdv.) "Fea / Texas" (RRI); "Fea / Texas" (ISM). Probably from the type series of *fea*.

Hemiargus isola (Reakirt) "Alce ♂ / Texas" (RRI); "Alce ♂ / Texas" (ISM). Probable syntypes of *alce* according to Brown.

Lycaeides melissa (Edw.) "Melissa ♂ / Col." (RRI).

Plebeius icarioides lycea (Edw.) "Lycea ♂ / Cal. O.B." (RRI); "Lycea ♀ / Cal. O.B." (RRI).

Plebeius acmon (Westwood and Hewitson) "Acmon / W.T. M." (RRI); "Acmon ♂ / Nev. Morr." (RRI).

Nymphalidae

Mestra amymone (Ménétriés) "Amymone ♂ / Texas" "Dallas, / Texas." (printed label; RRI); "Maidania / Texas" "Id. USNM / 11–23–36 / No. 3553" (typewritten label; RRI). Brown believes that "maidania" represents an unpublished manuscript name of Edwards.

Limenitis wiedemeyerii Edw. "Wiedemeyerii ♂ / So. Colo." (RRI). Probably from H. K. Morrison.

Vanessa carye Hübn. "caryae ♂ / Cal." (ISM).

Polygonia satyrus (Edw.) "Satyrus ♂ / Meads" (RRI). From Colorado and Theodore L. Mead, and probably one of the type series. Another specimen is of the subspecies *marsyas* (Edw.) and is labelled: "Marsyas ♀ / Colo." (RRI).

Polygonia zephyrus (Edw.) Two with identical labels: "Zephyrus / ♂ Col^o." (RRI). Brown believes that these are members of the type series.

Polygonia gracilis (Grote and Robinson) "Gracilis / W. Mts. 75" (RRI). White Mountains of New Hampshire.

Phyciodes texana (Edw.) "E. cincta ♂ / bred Oct 78" (RRI). Brown (1965) discusses the taxonomic significance of this specimen. I have applied an additional label reading "Phyciodes / texana / ♂ (Edw.) / Det. R.R. Irwin."

Phyciodes phaon (Edw.) "Phaon ♂ / Texas / July" (RRI); another male and a female similarly labelled but with small additional labels reading only "19" and "22" respectively (RRI); and another female also thus labelled but with no number (ISM). The meaning of the numbers is not known.

Phyciodes mylitta (Edw.) "Mylitta ♂ / W.T. M." (RRI).

Phyciodes campestris (Behr) "Pratensis ♂ / Neva." (RRI); an identically labelled specimen (ISM); "Pratensis ♂" "April" "Havilah / California" (RRI). As in the case of the specimen of *Strymon saepium* discussed previously, this is from Henry Edwards, probably having come originally from Stretch. The words "April" and "Havilah" are in the handwriting of Henry Edwards, while "California" is printed.

Phyciodes campestris montana (Behr) "Montana ♂ / Cal^a." (RRI); "Montana ♂ / Summit 7/17/76" (RRI). The latter is from the summit of Donner Pass, California, probably taken by Mead.

Phyciodes vesta (Edw.) "Vesta ♂ / Texas" "5" (RRI); "Vesta ♀ / Texas" "13" (RRI). As in the case of *phaon*, the significance of the numbers on separate bits of paper is unknown.

Satyridae

Coenonympha ampelos Edw. "Ampelos ♂ / W.T. M." (RRI).

Coenonympha california (Westwood) "Galactina ♂ / Lab." (ISM).

Cercyonis pegala pegala (Fabr.) "Pegala ♀ / Fla." "110 Cercyonis pegala Fbr. / From A.H. Mundt Collection / December 1936 R.M. Barnes" (RRI).

Cercyonis pegala nephele (Kirby) "Nephele ♂ / Catskills" (ISM); "Nephele ♀ / N York" (RRI).

Cercyonis pegala ariane (Bdv.) "Ariane ♂" (2 specimens ISM); "Ariane ♂ / Cal." (2 specimens ISM); "Ariane ♂ / Sod. Sp." (ISM); "Ariane ♂ / Sod. Sp. / Cala." (ISM); "Boopis / ♂ Oregon" (ISM); "Boopis ♂ / Oregon / Dodge" (ISM); "Boopis ♀ / Soda Sp. Cala." (ISM); "Boopis ♀" (ISM).

Oeneis ivallda (Mead) "Ivallda ♂ / Nev^{a}. M." (RRI).

Oeneis chryxus (Doubleday) "Chryxus ♂ / Big Horn 77" (RRI). Taken by Lt. Carpenter.

Oeneis jutta (Hübn.) "Jutta ♀ / Quebec" (RRI).

Oeneis melissa semidea (Say) "Semidea / ♂ W. Mts." (RRI); "Semidea / ♀ W. Mts. 75" (RRI). Probably from Denton or Scudder.

Erebia epipsodea Butler. "Erebia / rhodia / Colo." "Syntype / Erebia rhodia / W.H. Edwards / designated by / F.M. Brown '63" (RRI). See Brown (1964) for a discussion of *rhodia* with a reference to this specimen.

Acknowledgments

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TWO NEW SPECIES AND TWO NEW SUBSPECIES OF MEGATHYMIDAE FROM MEXICO AND THE UNITED STATES

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The first species described herein represents an extension of the range of the "*belli* complex" much farther south and east of previously known species. Since it is further removed from the other species it was not unexpected to see that it had major characters which differed from those of the known species. The treatment of the second species described here represents a major change in our procedure, for this is the first time that we have described a species based on a single specimen and without any knowledge of its biology; however this species is unique in so many ways that its description cannot be further delayed.

The two subspecies described herein are not described because of any great difference in their appearance; rather, they look somewhat alike. The significant thing about these two is that they probably represent parallel evolution of two widely separated populations rather than divergence in two closely related, geographically adjacent populations.

Agathymus ricei Stallings, Turner, & Stallings, new species

Female. Upper surface of primaries: flat black, with a few golden brown hairs at the base; spots yellow with a tint of brown; spot 1 square; spots 2, 3, and 4 rectangular, with spot 2 extending inwardly beyond the other two spots; spots 5 and 6 square, set well outside outer edge (extended) of spots 7, 8, and 9; spots 7, 8, and 9 almost square, of about equal size, forming a straight line on their outer edge, inwardly each spot is irregular with spot 8 distinctly convex; golden brown hairs at base extending outward one-third towards outer angle, terminating in an indistinct dull yellow patch, above the golden brown hairs extending outward along vein just below spot 1, terminating in a tiny patch of dull yellow just short of spot 1; fringes checkered dark smoke and white.

Undersurface of primaries: flat black, apex and outer margin well overscaled with white and between spots 1 and 2, 3, 4, 5, and 6 with yellow; all spots of upper surface reappear, lighter in color, spot 2 almost white; the two patches of color of the upper surface not appearing.

Upper surface of secondaries: flat black with golden brown hairs at base, extending outwardly, particularly in anal area; a well-defined discal band of spots, slightly darker than the spots on upper surface of primaries; a minute patch of dull yellow in median area; fringes checkered dark smoke and white.

Undersurface of secondaries: flat black, completely overscaled with white; discal band faintly represented by a slight increase in white overscaling.

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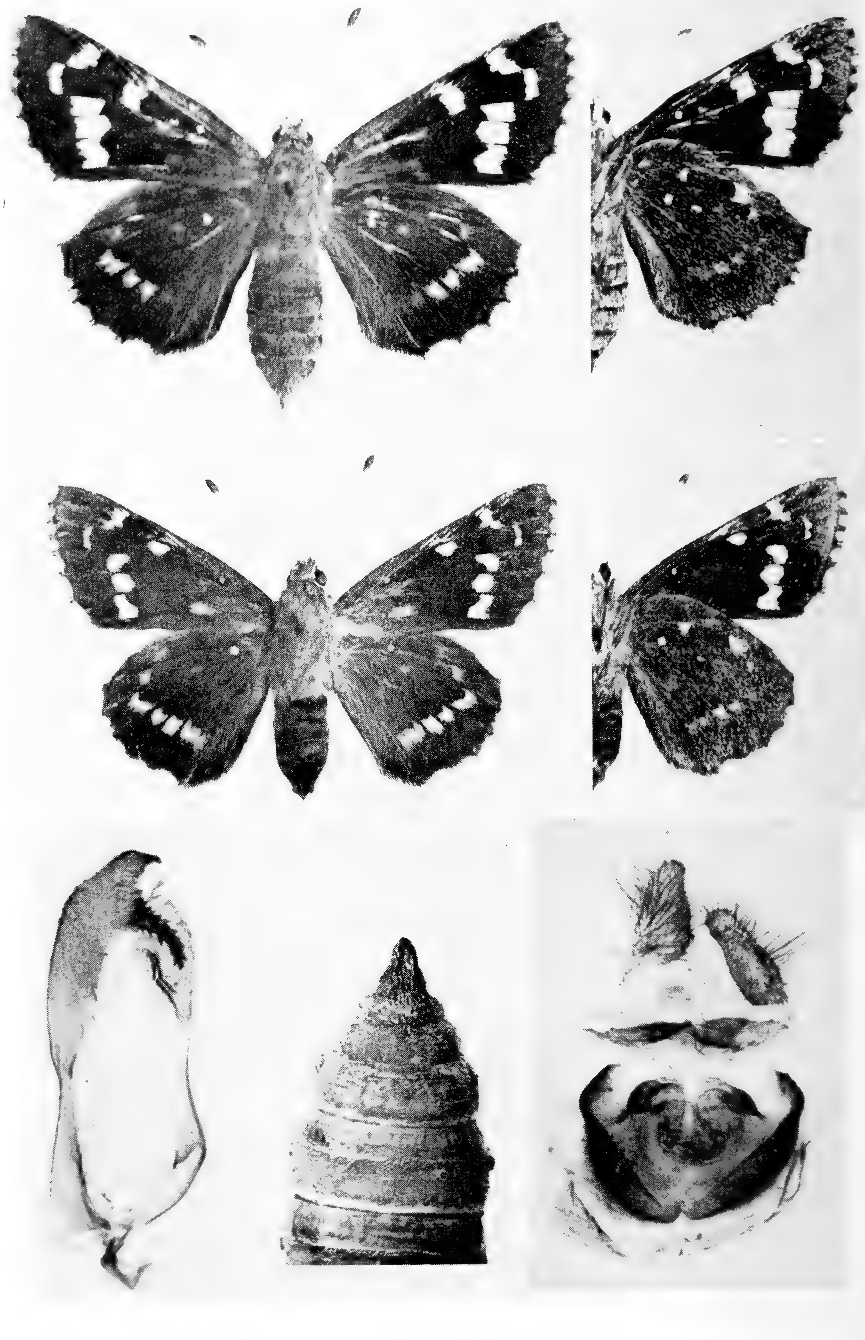

Abdomen: brown to black above with white overscaling beneath. Thorax: brown-black with golden brown overscaling above and white overscaling beneath. Palpus: white with numerous black hairs. Antenna: smoky black with narrow white rings.

Length of forewing: 22 mm to 26.5 mm; average 25 mm, measurements of holotype: forewing, apex to base 26.5 mm, apex to outer angle 16 mm, outer angle to base 19 mm; hindwing, base to end of vein Cu_1 19 mm.

Male. Upper surface of primaries: black, otherwise similar to female, except spots smaller, the lower patch of color more distinct, the upper patch very indistinct; with spot 8 round.

Undersurface of primaries: similar to female, except spot 3 also white.

Upper surface of secondaries: similar to female, spots of discal band brighter.

Undersurface of secondaries: similar to female, discal band more clearly defined by white overscaling.

Abdomen, thorax, palpus, and antenna similar to female.

Length of forewing: 22 mm to 24.5 mm, average 24 mm. Measurements of allotype: forewing, apex to base 24.5 mm, apex to outer angle 14.5 mm, outer angle to base 17 mm; hindwing, base to end of vein Cu_1 17.5 mm.

Holotype, female, allotype male, and 21 paratypes (13 males and 10 females), near Tepeaca, Puebla, Mexico, on Hwy. 150 at Km 165, elevation 7,000 ft, collected as larvae, emerging from Sept. 10 to Oct. 5, 1964. Collected by Mrs. R. C. Turner; Dr. and Mrs. J. R. Turner, Judy, Gayle, and J. R., Jr.; Mary Lee Turner; H. A. Freeman; Mr. and Mrs. Don B. Stallings.

Holotype, female, Sept. 27, 1964 and allotype, male, Sept. 25, 1964, will be deposited in the Peabody Museum of Natural History, Yale University; 13 paratypes are in the collection of H. A. Freeman and the remainder in the collection of the authors.

Specimens 30 km southeast of the type locality appear typical, but specimens 62 km southeast of type locality are not typical.

Foodplant: a large "Maguey" type of *Agave*; the leaves are yellow green, very broad and thin on the outer part, rather succulent, the plant has a very rosette shape with the bloom stalk being paniculate.

When collected the larvae were dull white with a few fine red-brown speckles, this was probably the next to last instar as later they were a light olive green color. Nearly all the larvae were found in very small plants, less than 18 inches high. The trapdoors were located on the underside of the leaves, and the leaves occupied were located more to

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EXPLANATION OF PLATE I

Agathymus ricei Stallings, Turner, and Stallings. Top row: Holotype female, Tepeaca, Puebla, Mexico, 27 September 1964; left, upperside; right, underside. Middle row: Allotype male, Tepeaca, Mex., 25 September 1964; left, upperside; right, underside. Bottom row: left, male valva, inner aspect; middle, posterior segments of pupa including cremaster; right, external genital structures of female, abdominal segments VIII–X, ventral aspect.

Explanation of plate II

Agathymus escalantei Stallings, Turner, and Stallings. Holotype female, Nochistlan, Guerrero, Mexico, May, 1958. Top: Upperside. Middle: Underside. Bottom: External genital structures, abdominal segments VIII–X, ventral aspect.

the center of the plant. The collecting area was at the base of a limestone hill. Very few larvae were found upon the hill.

We realized when we first saw the trapdoors that this species was related to *Agathymus evansi* (Freeman) and *Agathymus belli* (Freeman) for they were shiny jet black. However these trapdoors were somewhat different from those of *evansi* and *belli* in that the outer two-

thirds had a frosted effect, this frosted effect results from the incorporation of a whitish substance into the outer area leaving only the inner third shiny like *evansi* and *belli*. We note that the trapdoor of *evansi* has a slight indication of the incorporation of a lighter colored substance in the outer portion of the trapdoor. The trapdoor of this new species is round, 7 mm in diameter; the trapdoor of *evansi* is round, 8 mm in diameter; while the trapdoor of *belli* is oval, 9 by 10 mm.

This species must have some green in the flat black ground color, for on both undersurfaces the white overscales appear to be greenish.

The species is readily distinguished from both *evansi* and *belli* by its darker color, smaller spots and particularly spot 8 which is round in the male, and has the inner side convex in the female. In *evansi* and *belli* the spot is rectangular and in the female the inner side of the spot is concave.

Strangely, the genitalia appears closer to *evansi* than *belli*. The cremaster of the pupa case is shorter and more blunt than *evansi* or *belli*.

The larval cavity in the plant varies from 42 mm to 51 mm in the female and from 37 mm to 58 mm in the male. The larva places a few strands of silk across the cavity immediately below where it pupates.

Named for J. E. Rice Turner, Jr., the son of the second named author, who collected part of the type series.

Agathymus escalantei Stallings, Turner, & Stallings, new species

Female. Upper surface of primaries: dark brownish black with very few yellow hairs and scales at base, extending outward along costal edge and from base towards outer angle; spots creamy lemon-yellow; spot 1 longer than wide, with the outer edge rounded; spots 2, 3, and 4 rectangular, spot 4 somewhat broader; spot 5 absent and spot 6 a minute dot well outside the discal band; discal band, with spots 7 and 8 forming a straight line on their outer edges, with spot 9 set outward appearing disassociated from 7 and 8; spot 9 distinctly toothed inwardly; spot 8 nearly twice as long as spots 7 and 9, extending inward to inner edge of cell spot; spots 1, 7, 8, and 9 separated by only narrow lines of dark brownish black; spots 1, 7, and 8 appear to form a cluster of spots unlike any other *Agathymus*; fringes are checkered dark brownish black and smoky white.

Undersurface of primaries: dull brownish black, apex lightly overscaled with white; all spots of upper surface, plus spot 5, present; spots 2, 3, 4, 5, and 6 white, 1, 7, 8, and 9 as above, larger, particularly spot 9.

Upper surface of secondaries: dark brownish black with numerous yellow hairs at base and in anal area; discal band composed of four spots in a straight line, the upper two very distinct, the lower two, minute dots; fringes checkered like primaries.

Undersurface of secondaries: dull brownish black with white overscaling; discal band white, the more distinct spots appearing at lower edge of the band; one white comma-like spot inward in costal area.

Abdomen: dark brownish black above and brownish black below. Thorax: dark brownish black. Palpus: white. Antenna: dark brown with narrow white rings.

Measurements of holotype: forewing, apex to base 24 mm, apex to outer angle 15 mm, outer angle to base 18 mm; hindwing, base to end of vein Cu_1 18 mm.

Male. Unknown.

Explanation of plate III

Megathymus yuccae maudae Stallings, Turner, and Stallings. Top row: Holotype female, 21 mi. N Essex, San Bernardino Co., Calif., 9 March 1953; left, upperside; right, underside. Bottom row: Allotype male, 21 mi. N Essex, Calif., 14 March 1953; left, upperside; right, underside.

Holotype, female, Nochistlan, 20 km southwest of Acahuizetla, Guerrero, Mexico, May, 1958; deposited in collection of Tarsicio Escalante, Mexico, D.F.

The closest presently known species to this new species is *Agathymus fieldi* Freeman. It is distinguished from *fieldi* by the darker ground color, the lighter spots, which are much larger in the primaries and much smaller in the secondaries and particularly by the peculiar clustering of spots 1, 7, and 8. The wings of this species appear more fragile (thinner) than other species in the genus.

The genitalia are distinctly different, particularly in the elongated spur on each side of the sterigmal "plate."

This unique species is named for our good friend and fellow collector, Dr. Tarsicio Escalante of Mexico City.

Megathymus yuccae maudae Stallings, Turner, & Stallings, new subspecies

Female. Upper surface of primaries: black with a few yellow-green hairs near base; apex slightly overscaled with white; spot 1 rectangular, each corner extended outward slightly; spots 2, 3, and 4 of equal length; spots 5 and 6 rectangular, particularly spot 6; spots 7 and 8 about equal in size, broadly rectangular; spot 9 equal to 7 and 8, toothed inwardly, notched outwardly; spots 1, 7, 8, and 9 light yellow, spots 5 and 6 creamy yellow, spots 2 and 3 white, spot 4 white with a tinge of yellow; fringes checkered white with black.

Undersurface of primaries: black, outer margin overscaled with white, all spots of the upperside reappear, spots 2, 3, and 4 white, spots 1, 5, 6, 7, 8, and 9 creamy white, white portion of checkered fringe with a row of blackish scales half as long as the white scales.

Upper surface of secondaries: black with very few yellow-green hairs near base; light yellow spots of discal band, a minute dot with two small triangular spots below, followed by two well-defined roundish spots, inward side of latter four spots forming a straight line; broad creamy yellow margin; fringes white.

Undersurface of secondaries: black with costal area and outer margin overscaled with white; two triangular white spots in costal area, discal band indicated by slight mottling.

Abdomen: black above, dark gray to black below. Thorax: gray with greenish tinge above, darker below. Palpus: white with a few scales capped with black. Antenna: club above and below black, shaft ringed with white and black.

Length of forewing 29 mm to 33 mm, average 32 mm. Measurements of holotype: forewing, apex to base 32.5 mm, apex to outer angle 21 mm, outer angle to base 23.5 mm; hindwing, base to end of vein Cu_1 24 mm.

Male. Upper surface of primaries: black, similar to female with spots smaller and lighter in color; spots 7, 8, and 9 toothed inwardly.

Undersurface of primaries: similar to female with spots smaller, spots 2, 3, and 4 white, spots 1, 5, 6, 7, 8, and 9 creamy white.

Upper surface of secondaries: black with broad, creamy yellow margin.

Undersurface of secondaries: black, overscaled with white with two white triangular spots in costal area.

Abdomen, thorax, palpus and antenna same as in female.

Length of forewing 25 mm to 29 mm, average 27 mm; measurements of allotype: forewing, apex to base 28 mm, apex to outer angle 17 mm, outer angle to base 19 mm; hindwing, base to end of vein Cu_1 18.5 mm.

Holotype, female, and allotype, male: California, San Bernardino County, 21 miles north of Essex, on Cima Road in Providence Mountains. Described from 40 specimens (20 ♂♂ and 20 ♀♀), collected in the pupal stage by Dr. and Mrs. R. C. Turner emerging in confinement from 4 March 1953 to 17 March 1953. Holotype, female, 9 March 1953, and allotype, male, 14 March 1953, will be deposited in Peabody Natural History Museum, Yale University; paratypes are in the collection of C. L. Remington, H. A. Freeman, U. S. National Museum, and American Museum of Natural History.

Foodplant: *Yucca schidigera* (Roezl.) Ortgies.

This subspecies occurs in the Providence Mountains and northward in nearby Mojave Desert areas of eastern California. We have specimens

EXPLANATION OF PLATE IV

Megathymus yuccae elidaensis Stallings, Turner, and Stallings. Top row: Holotype female, Elida, Roosevelt Co., New Mexico, 9 April 1956; left, upperside; right, underside. Bottom row: Allotype male, Elida, N. M., 3 April 1956; left, upperside; right, underside.

from 17 miles east of Essex, in the Piute Mountains, and from the Soda Mountains near Baker.

This subspecies appears similar to *M. yuccae arizonae* Tinkham; however, the genitalia indicate that *maudae* is associated with *M. yuccae martini* Stallings & Turner. The new race is distinguished from *arizonae* by the length of the spots (longer) and the lighter color of the spots, and from *martini* by the larger spots, particularly in the female.

It is named for Maude Remington, the wife of P. S. Remington and mother of C. L. Remington; her charm is unforgettable.

Megathymus yuccae elidaensis Stallings, Turner, & Stallings, new subspecies

Female. Upper surface of primaries: deep brown-black with a few yellow hairs near base; a slight line of white overscaling from apex along outer margin; spot 1

rectangular; spot 2 nearly twice as wide as spots 3 and 4, extending outward; spots 5 and 6 roughly rectangular; spot 7 slightly shorter than spot 8; spot 8 slightly toothed inwardly; spot 9 as large as spot 8, with a toothed effect inwardly and a notched effect outwardly; spots 1, 7, 8, and 9 yellow, spots 5 and 6 light yellow, spots 2, 3, and 4 white; fringes checkered dark smoke- and brown-black.

Undersurface of primaries: brown-black, outer margin overscaled with white, all spots of upperside reappear, spots 2, 3, and 4 white, spots 5 and 6 yellow-white, spots 1, 7, 8, and 9 light yellow.

Upper surface of secondaries: deep brown-black, a few yellow hairs near base; yellow spots of discal band of two triangular spots, joined by two well-defined, squarish spots below, line formed by inward side of these four spots irregular; broad, light yellow margin, fringe white, showing a tint of yellow.

Undersurface of secondaries: brown-black, costal area and outer margin overscaled with white; two narrow, triangular, white spots located in costal area, discal band indicated by faint mottling.

Abdomen: deep brown-black above, brownish below. Thorax: gray-brown with yellow tint above, darker below. Palpus: white, a few scales capped with black. Antenna: club, above and below, black; shaft white ringed with faint brown-black.

Length of forewing 30 mm to 36 mm, average 34 mm. Measurements of holotype: forewing, apex to base 35 mm, apex to outer angle 21.5 mm, outer angle to base 24.5 mm; hindwing, base to end of vein Cu_1 23.5 mm.

Male. Upper surface of primaries: similar to female, spots smaller; spots 2, 3, and 4 white, spots 1, 5, and 6 white with considerable yellow scaling, spots 7, 8, and 9 light yellow; spots 5 and 6 each a crescent outwardly, spots 7, 8, and 9 slightly toothed inwardly.

Undersurface of primaries: similar to female with spots smaller; spots colored as above except a little lighter.

Upper surface of secondaries: deep brown-black with broad light yellow margin, fringes white with a slight tint of yellow.

Undersurface of secondaries: brown-black well overscaled with white, with two white triangular spots in costal area, there is often a minute white dot circled with brown-black in the center of the wing, if this dot is absent its location is evident from the lack of white overscaling within the brown-black circle.

Abdomen, thorax, palpus, and antenna same as in ♀.

Length of forewing 23 mm to 28 mm, average 27 mm. Measurement of Allotype: forewing, apex to base 28 mm, apex to outer angle 17 mm, outer angle to base 19 mm; hindwing, base to end of vein Cu_1 17.5 mm.

Holotype, female, and allotype, male: New Mexico, Roosevelt County, southwest of Elida. Described from 80 specimens (39 ♂♂ and 41 ♀♀), collected in the larval and pupal stage by Dr. and Mrs. R. C. Turner and Viola N. Stallings in 1956 and 1962. Specimens emerged in confinement from April 3 to May 13. Holotype, female, 9 April 1956, and allotype, male, April 3, 1956, will be deposited in Peabody Natural History Museum, Yale University. Paratypes are in the collection of C. L. Remington, H. A. Freeman, U. S. National Museum, and American Museum of Natural History.

Foodplant: *Yucca intermedia* var. *ramosa* McKelvey.

In 1956 this particular colony was located a few miles south of Elida, New Mexico on U. S. Hwy. 70 at an elevation of approximately 4,200 ft. In 1962 the colony was found 17 miles northeast of Elida, some 8 miles

southwest of Portales. The shifting of the location of the colony can be attributed to the wind. This subspecies occurs in a relative open country and the direction of the blowing wind during the flight period of the females will determine the location of the colony the following year as the females tend to drift with the wind as they oviposit. Thus we can expect colonies of this type shifting back and forth from year to year.

This subspecies occurs on the high plains of eastern New Mexico from south of Clayton southward to north of Lovington. It should also be found immediately east in west Texas.

This subspecies appears similar to *M. yucca arizonae* Tinkham; however, the genitalia indicate it is associated with *M. yucca coloradensis* Riley.

The New Mexico race is distinguished from *arizonae* by the length of the spots (longer) and the darker color of the spots and from *coloradensis* by its larger size and darker coloring of spots. It should be noted, however, that this is one of the few instances where we appear to have a north–south cline, from typical *coloradensis* to *elidaensis*.

A REVIEW OF THE *LIMENITIS LORQUINI* COMPLEX (NYMPHALIDAE)

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The *Limenitis lorquini* complex consists of two subspecies, one form, and four aberrations, according to C. F. dos Passos' 1964 Synonymic List of Nearctic Rhopalocera (pp. 75–76). *Limenitis lorquini burrisonii* Maynard and *Limenitis lorquini burrisonii* ab. *maynardi* Field are of particular interest; the former was assigned a subspecific standing while the latter is presently treated as an aberration.

It is the intention of the authors to discuss and elucidate the categorical treatment and designations of the presently recognized entities in the *lorquini* complex.

The southern complex

The original description of *Limenitis lorquini lorquini* (Boisduval) (Figs. 1 and 2) appeared in 1852 (Annales de la Société Entomologique de France, (2)10: 301). The type locality was cited as California. *L. l. lorquini* represents the typical, southern race of the species.

Limenitis lorquini form *eavesii*, Henry Edwards (Figs. 3 and 4), described from the vicinity of Virginia City, Nevada, differs basically

from typical *lorquini* in that it exhibits a well-defined row of orange spots distal to the median white band of the hindwing dorsally. In addition, *eavesii* also displays more extensive orange over the apical area of the forewing dorsally. Form *eavesii* not only inhabits Nevada but also California, occurring from coastal lowland and mountain localities in the southern counties to mountainous regions in the central and northern counties. An examination of Nevada and California material reaffirms that *eavesii* is a minority form, to be found at a variable rate of occurrence, within typical *lorquini* populations.

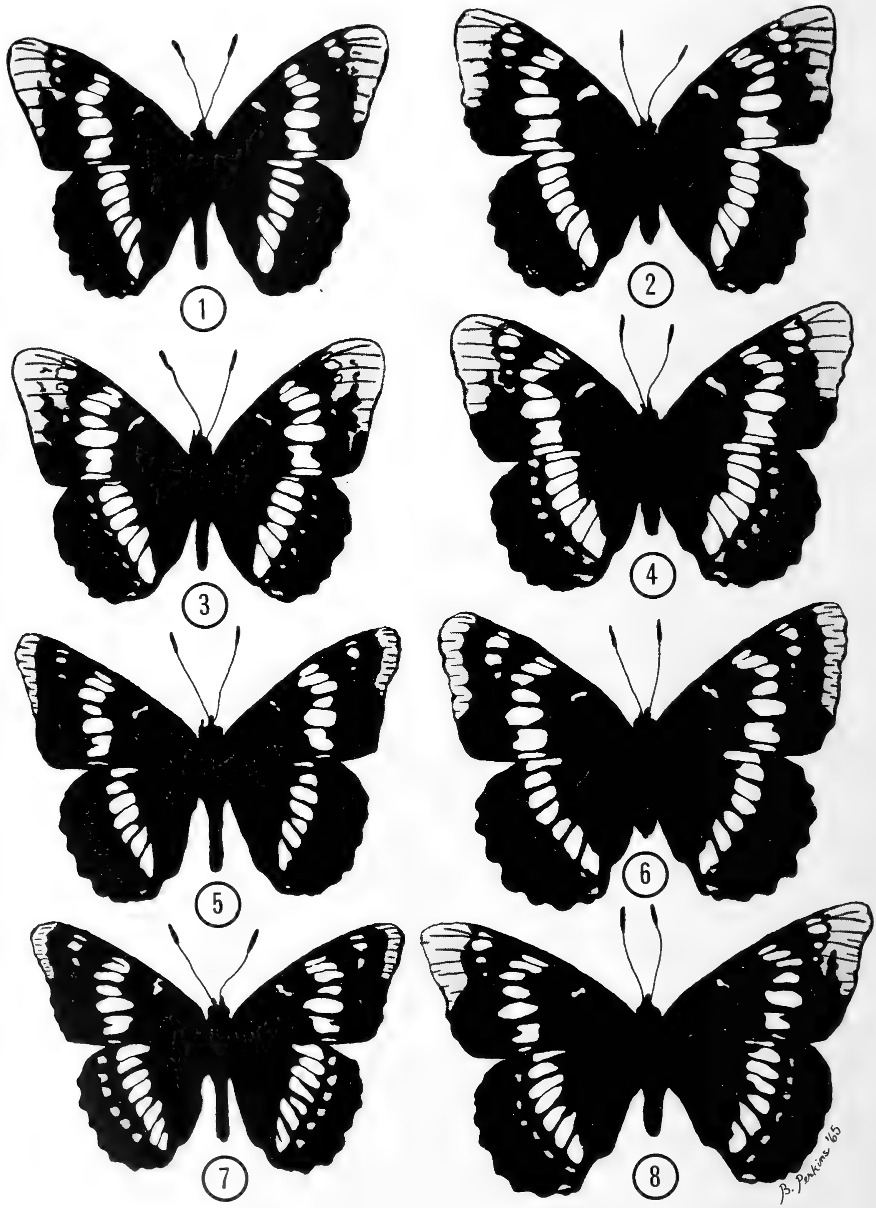
Form *eavesii* was not originally described in 1878 as the Synonymic List of Nearctic Rhopalocera indicates. C. F. dos Passos (*in litt.*) states: "*Limenitis lorquini* form *eavesii*, Hy. Edwards was published on page 172 of volume VII of the Proceedings of the California Academy of Sciences. The title page, insofar as material, reads (Volume VII, 1876—San Francisco, 1877) from which I deduce that the final signature (13) in which this name appears was not published until 1877. The preceding signature contains the minutes of a meeting held 18 December 1876. Consequently, I conclude that *eavesii* Hy. Edwards should be dated 1877." dos Passos further states: "There is a possibility that this name was published in 1876 since it appeared in Pacific Coast Lepidoptera, no. 22 and it is generally believed that these papers were distributed as separates by Henry Edwards before they were published by the Academy. However, under Article 21 of the Code, the publication of preprints is frowned upon."

L. lorquini from northern California retain the characteristic facies of the southern populations, although an occasional example possesses concomitantly reduced orange apical patches on the forewing dorsally and a somewhat darker ground color, ventrally. This tendency is preponderant in populations sampled in southern Oregon.

The northern complex

The subspecies typical of northern areas occurs in Oregon, Washington, British Columbia, Alberta, Idaho, and Montana. Individuals possess restricted (rarely absent) apical areas on the forewings above, which are dark, red–orange in hue. These specimens also present a somber, ventral ground color which becomes very melanotic in some individuals. The name which is presently applied to this northern race is *burrisonii* Maynard. Our investigation has shown this categorical concept and subsequent nomenclatorial designation to be in error.

We have examples of northern *lorquini* which are unusual in possessing a postmedian row of six well-defined, burgundy-red to orange spots, located distally to the median white band of the dorsal hindwings.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B. Perkins '65

As we were curious about this particular variation, which is phenotypically expressive in only 11.5 percent of the 338 northern *lorquini* examined, a representative specimen from west central Montana (Fig. 7) was forwarded to F. M. Brown, Colorado Springs, Colorado for his inspection and determination.

According to Brown, the specimen parallels the form originally described as *burrisonii* (Figs. 7 and 8) in 1891 (The Manual of North American Butterflies, p. 102). In his original description Maynard stated: "Differs from the typical *lorquini*, in the entire absence of any red in the apex of the fore wing above, and in the presence of a series of red spots outside the white band on hind wing, and there are indications of a sub-marginal series of spots." Maynard further states: "I have described above a form of *Limenitis* obtained by Mr. H. K. Burrison, in British Columbia, during July 1890, from Landsdowne, westward to Vancouvers Island." This description suggests that Maynard's type (although not specifically fixed) was a minority variant of the northern, red-spotted *lorquini* from which apical patches were lacking.

Field's *maynardi* (Figs. 5 and 6), considered to be an aberration, was described in 1936. The type locality was given as Vancouver, British Columbia. In his original description (Jour. Ent. Zool., Pomona, 28: 24–25), Field stated: "The northern form which lacks these red spots and which is similar in this respect to typical *lorquini* Boisduval is unnamed. I name it *maynardi* after the author of the red spotted form. . . ." Although Field was not specific regarding the nomenclatorial standing of *maynardi*, he did qualify its categorical treatment by adding the following note on page 25 of his original description: "If the common form of the northern race is the form without red spots, then *maynardi* will have to be listed as the normal form of the race. If not the normal form of the race *burrisonii* then this new form is a transition form representing melanism, black taking the place of red."

The original descriptions of both *maynardi* and *burrisonii* were so worded by their respective authors that both are categorically available

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Explanation of plate

Figs. 1–8. Ink and watercolor sketches of *Limenitis lorquini* complex: 1) ♂, *L. l. lorquini* (Bdv.), Tuolumne Co., Calif., 1-VII-64; 2) ♀, *L. l. lorquini* (Bdv.), San Diego Co., Calif., 27-VI-64; 3) ♂, *L. l. lorquini* form *eavesii* Hy. Edw., Inyo Co., Calif., 3-VII-63; 4) ♀, *L. l. lorquini* form *eavesii* Hy. Edw., Santa Barbara Co., Calif., 6-V-63; 5) ♂, *L. l. burrisonii form norm. maynardi* (Field), Yakima Co., Wash., 8-VIII-64; 6) ♀, *L. l. burrisonii form norm. maynardi* (Field), Flathead Co., Mont., 1-VII-61; 7) ♂, *L. l. burrisonii* Maynard, Ravalli Co., Mont., 7-VII-62; 8) ♀, *L. l. burrisonii* Maynard, Wasco Co., Oregon, 20-VI-64.

for usage in a subspecific designation. As both names apply to the same subspecific complex and as Article 23 of the International Code of Zoological Nomenclature indicates that it is mandatory for the earliest published name to be used as the subspecific nomen, *burrisonii* (the minority form described 45 years before *maynardi*) must be the name used to describe the northern subspecies. In order that this incongruity be made conspicuous, the following arrangement is proposed:

l. lorquini (Boisduval), 1852
  form *eavesii* Hy. Edwards, *1877*
    ab. *comstocki* (Gunder), 1925
    ab. *gunderi* (Field), 1936
    ab. *powelli* (Field), 1936
l. burrisonii Maynard, 1891
  form norm. maynardi (Field), 1936.

Conclusions

1) In light of the original descriptions and the frequency of occurrence of *maynardi* and *burrisonii*, it is apparent that *burrisonii* is to *maynardi* that which *eavesii* is to *lorquini.*

2) Although it has been demonstrated that *burrisonii* is an infrequently occurring, red-spotted minority form and that *maynardi* is the common and prevalent, normal form, adherence to the rules of the International Code of Zoological Nomenclature necessitates that *burrisonii* be the name applied to the northern subspecies of *lorquini.*

Acknowledgments

The authors are deeply indebted to Dr. C. F. dos Passos, Mendham, New Jersey, Mr. F. M. Brown, Fountain Valley School, Colorado Springs, Colorado, and Dr. J. A. Comstock, Del Mar, California for their assistance in nomenclatorial problems, the acquisition of publication data, and guidance in the preparation of this manuscript.

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For the use of their records and/or specimens, we thank Mr. J. H. Baker, Dr. F. H. Chermock, Mr. C. R. Crowe, Mr. T. W. Davies, Dr. E. J. Dornfeld (Oregon State University), Mr. S. Dvorak, Mr. S. L. Ellis, Mr. T. C. Emmel, Mr. R. L. Guppy, Mr. S. G. Jewett, Jr., Mr. N. LaDue, Mr. J. Manning, Mr. L. M. Martin (Los Angeles County Museum), Mr. D. McCorkle, Mr. C. W. Nelson, Mr. E. J. Newcomer, Mr. J. R. Pease, Mr. K. Roever, Prof. G. J. Spencer (University of British Columbia), and Mr. R. F. Sternitzky.

THE LIFE HISTORY OF *ATRYTONE AROGOS* (HESPERIIDAE)

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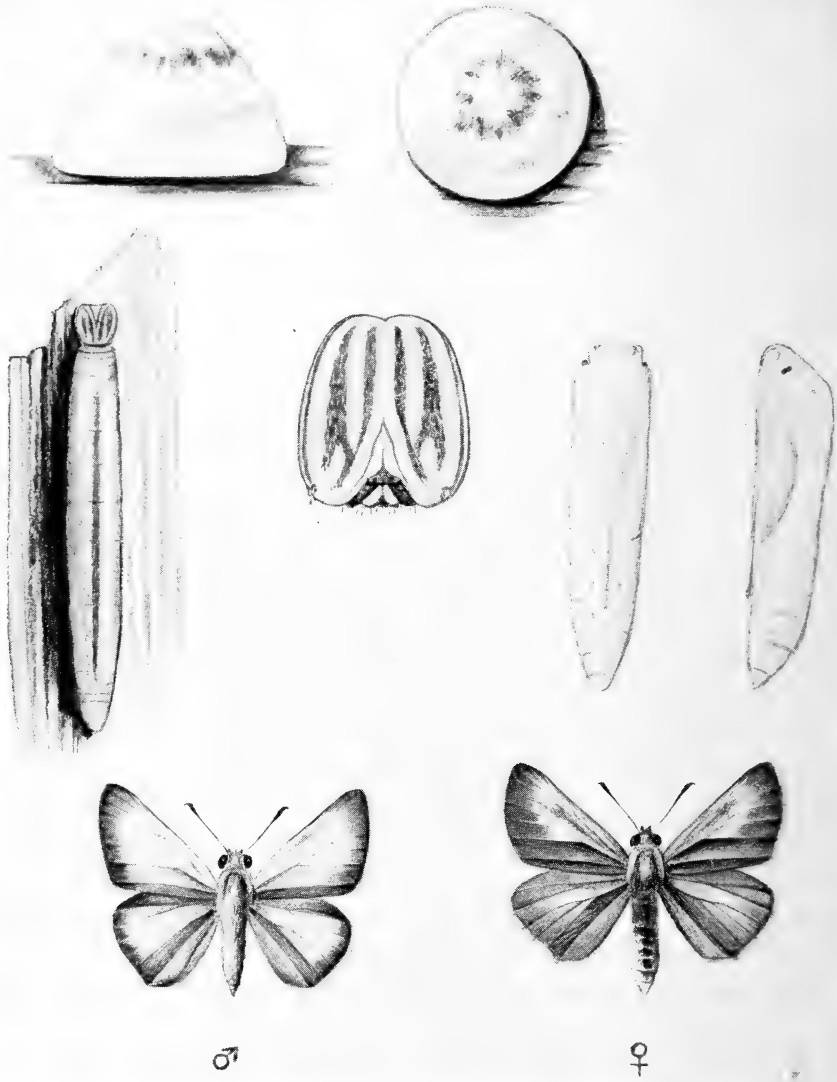
Among millions of acres devoted to cultivation and grazing in the central midwestern United States, it is still possible to find widely scattered areas of original virgin prairie. These prairie locales are all that remain of the characteristic flora which once covered vast portions of the region. Those surviving meadows provide the entomologist with a rich treasure of insect life. Here are found many elusive species unable to adapt to a radically changed environment. Lepidopterists in particular are keenly aware of these insect oases and keep careful record of their locations. Several of our most distinctive butterflies have found their "last stand" here, and with the eventual destruction of the prairie will disappear from our insect fauna. The regal fritillary *Speyeria idalia* (Drury) is perhaps the best-known example of this group.

One of the lesser known species is the small orange hesperid, *Atrytone arogos* (Boisduval & LeConte). While intensely local, *arogos* has periodic increases in numbers, becoming rather common in its limited habitat. The superficial resemblance to *Atrytone deleware* (Edwards) probably accounts for its being passed over by many collectors. With their bright orange coloration, the adults are easily sighted sitting atop the large purple cone flowers (*Echinacea*), the most characteristic flower of the prairie. Catching this skipper, however, is an entirely different matter. The males are wary and easily startled making their capture difficult. Females are not quite as wary and are prone to fly slower and for shorter distances than the males. The primary flight period occurs during early June with a less numerous second brood in early September.

The 1964 season was exceptionally good for this species, providing ample opportunity for observations and life history studies. The host plant selection of wild females is beard grass (*Andropogon*), in this instance *A. gerardi* Vitm. The genus *Andropogon*, a favored host by the subfamily Hesperiinae, serves for at least five other species in this area. Females of *arogos* lay their eggs singly on the undersides of grass blades two or three inches below the tips. A female taken from a meadow five miles west of Lawrence, Kansas, in June, produced 17 ova from which 13 larvae were reared. Four of these larvae completed development and produced imagines in September. The remaining larvae began hibernation shortly after entering the fourth instar. These hibernating larvae remained in their tube tent on the host plant during the rest of the



EXPLANATION OF PLATE

Life stages of *Atrytone arogos* (Boisduval & LeConte). Upper: Egg, lateral and dorsal aspect. Middle: Mature larva, dorsal aspect and enlarged, anterior aspect of head capsule; pupa, ventral and lateral aspects. Lower: Adult male and female, from prairie meadow, 5 mi. W Lawrence, Douglas Co., Kansas.

summer, fall, and following winter. The final instars were completed the following spring, with adults emerging in June.

It is interesting to note that an unpublished water-color painting by John Abbot depicts a male and female *A. arogos*, a pupa and a larva feeding on a species of *Panicum*, presumably in Georgia. If the association is correct then grasses belonging to the genus *Panicum* may augment or replace *Andropogon* species as a host in some areas.

The following descriptions are based on the series reared from Lawrence, Kansas:

EGG. Hemispherical, slightly flattened on top with micropyle protuberant. Height 1.10 mm, width 1.20 mm. Creamy white, circled by two pale red, irregular bands; lower band faint or broken in some examples.

On the sixth day there is a slight darkening of the micropyle. Eclosion occurs on the seventh day. The entire eggshell is devoured upon emergence.

FIRST INSTAR LARVA. When freshly emerged, pale creamy white with a few long white setae, mostly on anal segment. Prothoracic shield dark brown. Head pale orange-brown. Mandibles, labrum, and lines of epicranial suture dark brown. A few pale setae scattered over head.

The first action of the larvae is the construction of a small tent about 10 mm in length along the side or at the tip of a grass blade. Larvae begin eating the second day after emergence, with small notches taken from the leaf edge above or below the tent. Shortly after feeding the general body color changes to a pale translucent green.

SECOND INSTAR LARVA. Body pale grayish green dorsally, abdominal regions very pale grayish white. Anal and thoracic segments pale yellowish white. Prothorax white, prothoracic shield marked with a very narrow light orange-brown band. A few white setae on anal segment. Head pale orange-brown with grayish white bands; stalk of epicranial suture brown with a parallel narrow white band at each side; a wide grayish white band follows outer edges of epicranial plates to apex. Back of head white with a very narrow orange-brown band circling prothorax. Frons orange-brown with two short vertical white dashes. Mandibles dark brown. No noticeable setae on head.

THIRD INSTAR LARVA. Body dull grayish green, prothorax and anal segments paler. Prothoracic shield with a very pale orange-brown band; a narrow white spiracular, lateral line and a dark green middorsal line, fading out in thoracic region. A few short, white setae present on anal segment. Head pale orange-brown; outer edges of epicranial plates widely ringed with grayish white, becoming narrower at vertex, intersected by two narrow bands that parallel suture lines. Frons edged inwardly with white, containing two small, vertical, white dashes. A few short, white setae visible on head, mostly around outer edges of epicranial plates.

By this stage the larvae live in a tent of about 40 mm length, composed of two leaves drawn together and sealed tightly, open only at the bottom.

FOURTH INSTAR LARVA. Body pale grayish green. Anal segment and prothorax pale cream colored. Prothoracic shield with a very narrow, brown, dorsal line; a

dark green middorsal line and a narrow white spiracular, lateral line. Integument translucent, spiracles inconspicuous. No noticeable setae with exception of a few white ones on dorsal area of anal segment. Head grayish white with orange-brown bands as follows: a narrow band circling outer edges of epicranial plates, beginning just above the ocelli; arms and stalk of epicranial suture bordered by narrow lines, stopping just short of vertex, with a wider band parallel to sutures; frons grayish white with narrow edging and vertical dash of orange-brown extending a short distance into suture line. Labrum pale orange-brown, mandibles black, ocelli dark brown. A few pale setae scattered over head.

FIFTH INSTAR LARVA. Body pale grayish green with dark green middorsal heart line fading at thorax. Intersegmental folds bright yellow. Integument translucent, covered with very fine white setae, a few longer hairs on anal segment. Prothorax pale cream colored, prothoracic shield inconspicuous, pale orange-brown. Head white with orange-brown bands and markings: arms and stalk of epicranial suture bordered by narrow bands, stopping short of vertex and ocelli, wider opposite vertical stalk of suture; epicranial plates bordered by a narrow band; each epicranial plate with a median, vertical streak of orange-brown, broad at base, with an arm extending into suture band, tapering to a thin point at upper end, stopping short of vertex. Frons white with a narrow outward tracing and central dash of orange-brown. Labrum pale brown, mandibles black. Head slightly granulose with minute white setae visible.

FINAL INSTAR LARVA. Length 33 to 36 mm, width 5 mm, width of head capsule 4 mm. Body pale yellowish green dorsally with yellow intersegmental folds. Anal segment and abdominal regions light green without yellowish tint. Prothorax paler green. Prothoracic shield inconspicuous, tan. Thoracic and anal spiracles visible as white dots, other spiracles not noticeable. A dark green middorsal heart line. Integument translucent with a very smooth appearance. Only a few setae visible under $20\times$ magnification. Head grayish white, covered with scattered white setae. Frons edged with a narrow, orange-brown line and containing a short central dash of the same color. Suture lines outlined with bands of orange-brown which stop short of vertex; a band of orange-brown circles outer edges of epicranial plates, stopping short of the bright orange ocelli; A large vertical dash of orange-brown in center of each epicranial plate, wide at bottom where it joins suture band, tapering to a narrow point where it ends below vertex. Labrum pale orange-brown, clypeus darker brown, mandibles dark brown and black. Setae are not noticeable except along lower edges of epicranial plates.

In the final instar the larval tent averages 50 to 70 mm in length. An odd feature of larvae in the fourth, fifth, and final instars is the sealing of the tent during moulting, with a two-day time lapse occurring during this procedure. This peculiarity has not been observed for other Hesperiidae, but it undoubtedly gives a great degree of protection during this vulnerable period of the larval development.

The cocoon is constructed between two large grass blades near the top of the leaves, often three to four feet above the ground. The leaves provide the basis of the cocoon, which is made up of a thin lining of silk and a cap of fluffy silk which covers the head of the pupa as it rests in a vertical position.

PUPA. Length 18–20 mm, width at wing cases 4.5 mm. Pale yellow with thorax and dorsal side of abdomen brighter yellow; wing cases, tongue case and two final abdominal segments white. Tongue case detached, extending only 3 mm below wing cases. Thoracic spiracles prominent, bright orange-brown. A few inconspicu-

ous, gray markings about head and eye cases; scattered reddish setae over head. Entire abdomen covered by these setae, most numerous on last three segments. Cremaster short, bluntly rounded, lacking any distinguishing projections; lateral edges thickly lined with reddish setae; cremaster white, only slightly curved ventrally.

Larvae completing development within one summer followed a concise schedule. Instars one through five requiring eight days each while the final instar, surprisingly, required 18 days. Pupation occurred two days after construction of the cocoon. Imagines emerged in 12 days. Larvae which hibernated in the fourth instar sealed themselves into a small case between two grass blades on the plant. These tents were allowed to remain open until mid-September when they were sealed at both ends in preparation for winter.

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I would like to express my thanks to William H. Howe of Ottawa, Kansas, for the illustrations of the life history which accompany this article.

A NEW SPECIES OF *AGATHYMUS* FROM TEXAS (MEGATHYMIDAE)

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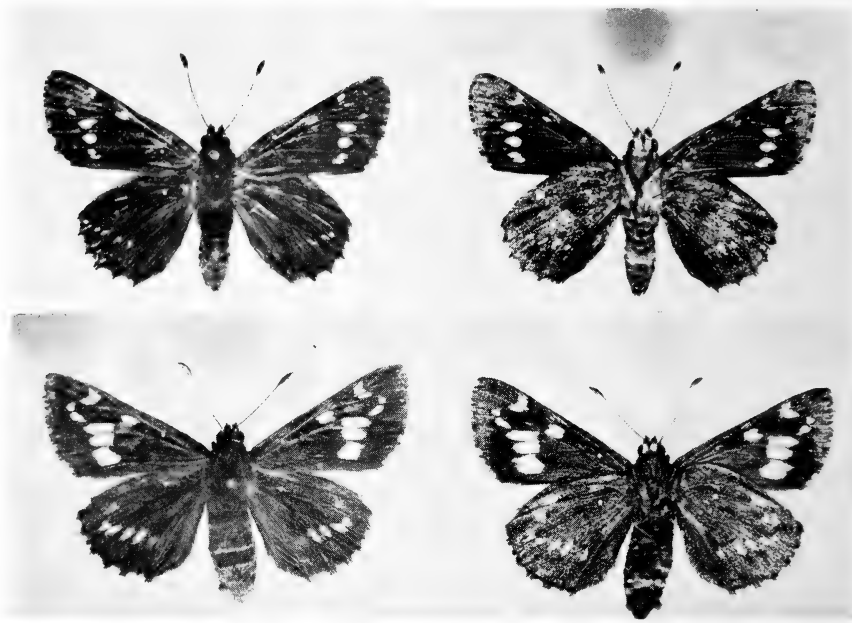
In making a study of the various complexes present in the genus *Agathymus* it was discovered that there are a number of species present in the *remingtoni* complex other than *estelleae* (Stallings & Turner) and *comstocki* (Harbison), most of which are found in Mexico. After carefully studying the morphology of specimens collected in the general vicinity of Del Rio, Texas it was found that this population represents an undescribed species in this complex. For several years I have been associating these specimens with *estelleae* from General Bravo, Tamaulipas, Mexico. After collecting rather extensively over Mexico during the past three years in association with the Stallings & Turners, I found that I had been connecting these specimens with another species. Actually, in many respects, they show a closer relationship to the mountain species *remingtoni* (Stallings & Turner) than they do to *estelleae*, which is a plains species. They show less relationship to *comstocki* than to either of the other two species.

[1] I would like to express my appreciation to the National Science Foundation for research grants G-9900 and GB-398 which has made this research possible.



EXPLANATION OF PLATE I

Agathymus valverdiensis Freeman. Top row: Paratype male, 14 mi. N Bracketville, Kinney Co., Texas, 4 October 1962; left, upperside; right, underside. Bottom row: Paratype female, 14 mi. N Bracketville, Texas, 15 October 1962; left, upperside; right, underside.

Agathymus valverdiensis Freeman, new species

FEMALE. Upper surface of primaries: dark brown–black, base overscaled with brownish hairs. Markings dull yellow, as follows: spot 1 (cell spot) often divided by dark vein, appearing as two spots. Spots 2, 3, and 4 elongated between veins. Spot 5 small, triangular. Spot 6 elongated, often pointed at each end. Spot 7 straight on inner surface, pointed on outer surface, broad (4–5 mm), extending under spot 6. Spot 8 same shape as 7, sometimes not as broad. Spot 9 broadly V-shaped, with point directed toward anterior portion of thorax. Fringes checkered brown–black and sordid light yellow.

Upper surface of secondaries: dark brown-black, with some overscaling of brownish hairs near base and toward anal angle. Markings dull yellow: Discal band usually composed of 4 narrow streaks, pointed at outer end, the point directed toward outer margin of wing. At times a spot above outer discal spot, sometimes a phantom, fifth discal spot in the band. All spots in a straight line. Fringes checkered brown and sordid yellowish-white.

Under surface of primaries: dull brown–black, with some light gray overscaling near apex. All spots reappearing, of about the same coloration as above.

Under surface of secondaries: dark brown, heavily overscaled with light gray. Several areas with the overscaling sparse, the darker ground color evident, giving the wing a mottled appearance. Two indistinct subcostal spots, sordid white. Discal spots often well defined, sordid white, outlined dark due to absence of the light gray overscaling.

Abdomen: dull dark brown above and below. Thorax: dull olive brown above, grayish below. Palpi: brown above, white below. Antennae: club brown, except base, white; shaft white, ringed with brown at joints.

Length of primaries 23–26 mm, average 25 mm. Wing measurements; holotype: primaries: base to apex, 25 mm; apex to outer angle, 15 mm; outer angle to base, 19 mm, secondaries; base to end of Cu_1, 19 mm; costa to anal angle, 15 mm; total expanse 50 mm (average of paratypes 50 mm).

MALE. Upper surface of primaries: dark brown–black, with some overscaling of brownish hairs near base. Spots smaller and lighter in color than those of female, light tan, with spot 7 oval, not reaching inner edge of spot 6. Sometimes spot 9 divided into two by dark scaling of a vein extending through it. Fringes checkered dark brown and sordid white.

Upper surface of secondaries: dark brown–black, with some brownish hairs extending down anal fold. Discal band a straight line of four, small, streak-like, light tan spots, pointed toward outer margin. Fringes checkered brown and sordid white.

Under surface of primaries: dull brown–black, with heavy overscaling of light gray from apex to two-thirds the distance down outer margin. All spots reappear, paler.

Under surface of secondaries: dull, dark brown–black, heavily overscaled with light gray. Ground color showing through in some areas, presenting a rather mottled appearance. Subcostal and discal spots sordid white, discal spots usually edged with dark. Anal fold dark brown–black with practically no overscaling of gray scales.

Abdomen: dull, dark brown above, grayish beneath. Thorax: dull, dark brown above, grayish beneath: Palpi and antennae as in female.

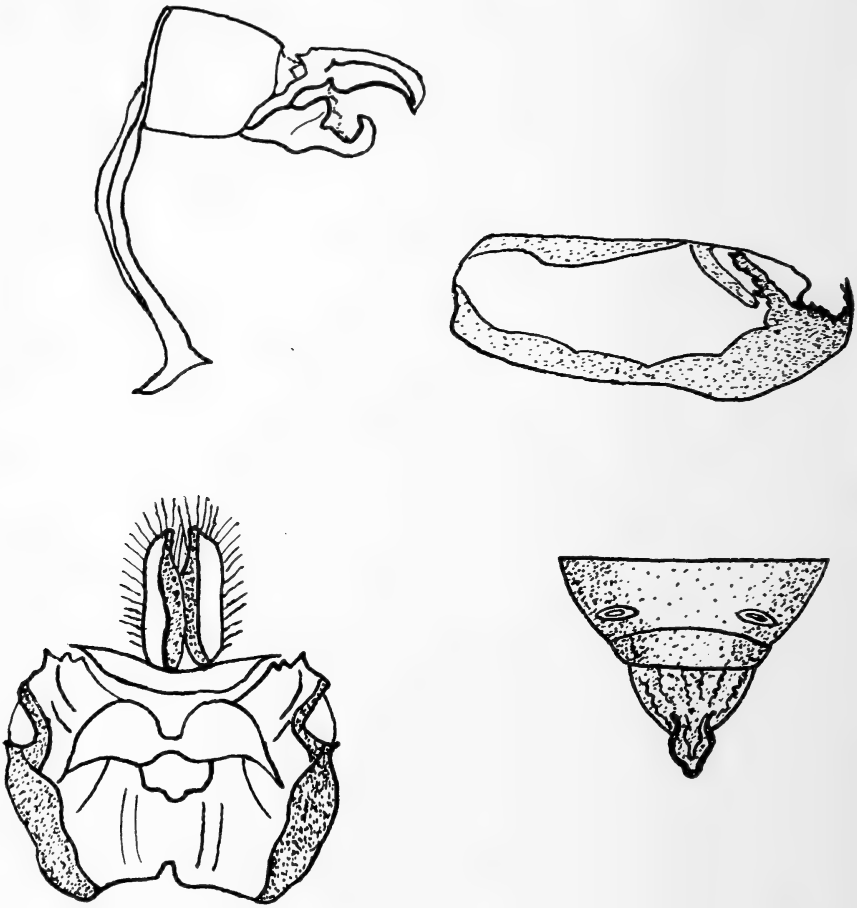
Length of primaries, 21–24 mm. Wing measurements; allotype: Primaries: base to apex, 23 mm; apex to outer angle, 13 mm; outer angle to base, 18 mm; secondaries: base to end of Cu_1, 17 mm; costa to anal angle, 14 mm; total expanse 46 mm (average of paratypes 46 mm).

Holotype, female: 28 miles north of Del Rio, Val Verde County, Texas, 16 September 1963, reared in atypical *Agave lecheguilla* Torr.; allotype male, same location and food plant, 13 October 1963, both were collected by the author and will be deposited in the American Museum of Natural History.

Described from 86 specimens, 46 ♂♂ and 40 ♀♀, all from Texas, as follows: 42 ♂♂ and 33 ♀♀ were collected by the author at 28 miles north Del Rio, 10 miles south Juno, Val Verde Co., and 14 miles north of Bracketville, Kinney Co.; 4 ♂♂ and 7 ♀♀ were collected by Stallings & Turner at the Del Rio and Bracketville locations. Adults emerged during September and October from 1958 to 1963.

The type locality is a rocky, limestone hill, elevation 1,450 feet, and the pH of the soil at the feeding level of the plants is 7.1. Plant associates are *Nolina*, sotol, catclaw, mesquite, scrub cedars (*Juniperus*), *Yucca reverchoni*, and *Yucca thompsoniana.* The Juno and Bracketville locations are very similar to the type locality. Paratypes will be placed in the following museums: United States National Museum, Yale University, Stallings & Turner, San Diego Natural History Museum, and Los Angeles County Museum. The remaining paratypes are in the collection of the author.

The food plant is a species related to *Agave lecheguilla*, possibly



EXPLANATION OF PLATE II

Agathymus valverdiensis Freeman. Top row: Male genitalia; left, tegumen and uncus, lateral aspect; right, valva, inner aspect. Bottom row: Female; left, external genital structures, ventral aspect; right, pupal cremaster.

undescribed. The larvae are white and seem to prefer the upper surface of the leaf for the usual construction of their trapdoors, however a few make them on the lower surface. When collected, the larvae had their heads directed toward the hole in the leaf, their caudal legs toward the lower surface of the leaf. The trapdoors are somewhat better constructed than those of related species in Mexico, and often the doors are hard to distinguish from those of *Agathymus gilberti* Freeman and *A. rindgei* because they are tan. The frass is ejected out of a hole which the larva

cuts in the leaf. The larvae seldom penetrate into the caudex of the plant but feed primarily at the base of the leaf. Often they feed in the same plant with *A. gilberti*, which feeds in the leaves toward the lower caudex, and *A. rindgei*, which feeds somewhat higher in the leaf and only into the upper caudex. Larvae collected in the summer emerge as adults during September and October of the same year. Roy O. Kendall made an interesting discovery during March, 1965, at the type locality, where he found two pupae of *valverdiensis* which emerged the following April. This presents some interesting questions which cannot be answered at the present.

In comparing *valverdiensis* with other members of the *remingtoni* complex, the following differences are noted: the ground color is darker than that of *remingtoni*, much darker than that of either *estelleae* or *comstocki*; females of *valverdiensis* have spot 7 directed well under spot 6, which occurs rarely in *remingtoni*, never occurring in the other two species; the spots are reduced in the males, especially the discal band of the secondaries, which is made up of small dashes instead of regular spots which occur in the other species; the females show this same general characteristic; one of the most distinguishing differences is the position of the discal band of the secondaries as it is situated higher up on the wing than in any of the other species in this group. There are genitalic differences which can be noted in the figure, as well as differences in the cremaster from the other species in this complex.

I would like to express my thanks to Mr. Don B. Stallings for the photographs of the adults used in this article.

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CERCYONIS PEGALA PEGALA (SATYRIDAE): OCCURRENCE IN MISSISSIPPI AND VARIATION IN FOREWING MACULATION

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Only four Mississippi records, involving eight specimens, of *Cercyonis p. pegala* (Fabricius) were known to Mather and Mather (1958). Subsequent collecting has increased these numbers, so that when in 1964 Dr. J. W. Tilden indicated a wish to obtain *Cercyonis* specimens for study, a total of 27 Mississippi specimens were available and were sent to him. Based on his study of these specimens he concluded that the Mississippi population represented by them had correctly been assigned to *C. p. pegala.*

Three of the eight specimens recorded by Mather and Mather (1958) were not available for inclusion in the series studied by Tilden. Two of these were collected by H. I. O'Byrne: a female taken on 22 August 1940, at Maxie, Forrest County, and a male taken on 2 September 1940 at Gulfport, Harrison County, both are in the collection of the University of Missouri, Columbia, Mo.; the third was collected 24–25 July 1956 by John L. Daniel at Shelby State Park, Forrest County, and is in his collection. The series of 27 examined by Tilden included specimens taken on dates in July, August, and October, at localities in three counties in southern Mississippi. There were 12 males and 15 females.[1] Twenty (nine males and 11 females) have one eyespot in the yellow patch on the forewing upperside, seven (three males and four females) have two such spots. Data on these 27 specimens are given in Table I.

Mr. Lucien Harris, Jr., Avondale Estates, Georgia, kindly examined the 14 Georgia specimens (eight males, six females) in his collection from middle and southern Georgia that are assignable to *C. p. pegala.* The results of his examination are given in Table II.

It has been suggested in the literature that in *C. p. pegala* individuals with one eyespot on the forewing upperside are males and those with two are females. As indicated by the data in Table I, the available sample of the Mississippi population does not follow this rule. A close examination of the literature reveals that the occurrence of males with two spots and of females with one spot has been noted by Klots (1951) and by Clark and Clark (1951). Relevant quotations are given below. Holland (1931) stated that "the broad yellow submarginal band on the primaries" was "marked with a single eye-spot in the male and two eye-

[1] The sex of each specimen was determined and reported by Dr. Tilden.

Table I.—Frequency of eyespots in yellow patch on forewing upperside in Mississippi *Cercyonis pegala pegala*

Date	Locality	County	Collector	Males		Females	
				One	Two	One	Two
24 Jul. 56	Shelby State Pk.	Forrest	J. L. Daniel	2	–	–	–
25 Jul. 56	Shelby State Pk.	Forrest	J. L. Daniel	1	–	1	–
31 Jul. 60	Fontainbleau	Jackson	B. & K. Mather	1	–	–	1
31 Jul. 60	Fontainbleau	Jackson	M. & E. Roshore	–	–	–	1
31 Jul. 60	Escatawpa	Jackson	M. & E. Roshore	2	–	2	–
1 Aug. 58	Shelby State Pk.	Forrest	B. & K. Mather	1	1	4	–
1 Aug. 58	Shelby State Pk.	Forrest	M. & E. Roshore	1	1	2	1
1 Aug. 60	Shelby State Pk.	Forrest	M. & E. Roshore	1	–	–	–
1 Aug. 60	Benndale	George	B. & K. Mather	–	–	1	–
1 Aug. 60	Fontainbleau	Jackson	B. & K. Mather	–	–	1	–
2 Aug. 58	Ocean Springs	Jackson	B. & K. Mather	–	–	–	1
3 Oct. 53	Fontainbleau	Jackson	B. & K. Mather	–	1[1]	–	–
Totals				9	3	11	4
				12		15	

[1] Reported incorrectly as a female (Mather and Mather, 1958).

spots in the female." Weed (1926) wrote ". . . with one eye spot in middle space of the blotch on the male, and two on the female." Klots (1951) stated that it had a "tendency to reduce or lose the lower ocellus in orange FW patch." He figured (Plate 7, fig. 6) a male from North Carolina with two eyespots. Ehrlich and Ehrlich (1961) figured (Fig. 160) a Georgia female with two spots. Kimball (1965) figured (Plate I, fig. 30, 31) two Florida females both with two equally large spots. Forbes (1960) wrote "Male normally with one, female with two large blue-pupilled ocelli in the patch." He described the specimen figured by Klots (1951) as an "aberration with a second ocellus in male." Clark and Clark (1951) wrote "Throughout most of the range in the south the lower eye spot on the forewings is lacking in both sexes; in North Carolina most of the females have this eye spot more or less developed; in northern North Carolina and Virginia all the females have two eye spots and the males begin to acquire the lower eye spot; north of Virginia Beach both sexes showing both eye spots equally developed."

The population of *C. p. pegala* in southern Mississippi, judged by the data from the available sample, has two eyespots present in about one-third of the individuals and the presence or absence of a second spot is not related to the sex of the individual. Three of 12 males and four of

TABLE II.—FREQUENCY OF EYESPOTS IN YELLOW PATCH ON FOREWING UPPERSIDE IN GEORGIA *Cercyonis pegala pegala*

Males				Females		
One spot	Two Spots			One Spot	Two Spots	
	Equal	Lower Smaller	Lower Greatly Reduced		Equal	Lower Somewhat Reduced
5	–	1	2	–	5	1

15 females have two spots. This population is thus approaching that described by Clark and Clark (1951) as inhabiting "most of the region in the south" where "the lower eye spot on the forewings is lacking in both sexes." The population in Georgia appears much more uniformly to have one spot on males and two spots on females.

From these data it is concluded that the use of the number of eyespots on the forewing upperside as a basis for determination of sex of individuals of *C. p. pegala* is unreliable. The variation of number of these eyespots merits further study on a geographic basis. It appears incorrect to regard the male from North Carolina figured by Klots (1951) with two spots as an "aberration" as was done by Forbes (1960) since Clark and Clark (1951) had noted that in North Carolina males may have two eyespots.

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"SEX-RATIO" IN *PIERIS* HYBRIDS

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Those lepidopterists who have worked with interspecific hybrids will be aware that in many instances female hybrids are very difficult to obtain. This is in accordance with the rule of Haldane (1922) that in all such hybrids it is the heterogametic (XY) sex which is the less vigorous, less numerous, and less fertile. In hybrid Pieridae, developmental disturbances which affect only the female range from mere changes in the incidence or length of diapause to its indefinite extension leading to death (Bowden, 1957). In experimental conditions it may easily happen that diapause pupae, which would eventually have produced imagines, are meanwhile adversely affected by those conditions and die before they can do so. A sex-ratio effect which is to some extent spurious can thus be produced.

Therefore, in assessing numerical breeding results, that is, the numbers of the sexes (as of other phenotypes) reaching the imaginal state, it is useful to have some estimate of the losses that have occurred, and particularly to know at what stages of development they took place. Losses in the egg, or of very young larvae, point to lethal combinations, especially if losses are few among more mature larvae. At least in *Drosophila*, some lethal factors do become operative in the last larval instar (Hadorn, 1961), but in *Pieris* losses which increase during the feeding of a brood can often be recognized as due to a bacterial or other disease; blacking-off commonly follows among the pupae. Losses at the time of pupation are by no means always due to infection; particularly when not preceded by larval losses, deaths at this stage also may be attributable to lethals. Of course, it is not suggested that losses by disease have no genetic aspect: it may well be that different genotypes possess different resistances.

The advantage of one genotype over another, as reflected in breeding results, is always relative to the conditions obtaining during the experiment. Although selection by disease or bad management can be very severe, it is seldom as rigorous as that operating in natural conditions, where one pair produces one pair. This being so, any attempt to establish by breeding a change in the degree of some genetic advantage with the passage of years (supposedly due to gene-complex selection) is extremely hazardous, and even more difficult when results of different breeders are compared.

The present paper is concerned principally with a series of related

hybrid *Pieris* broods in which males were underrepresented, in apparent contradiction to Haldane's rule.

Experimental

In a previous publication in this journal (1958) the present author reported on the occurrence of sexual mosaics among inter-subspecific or -specific hybrids within the European *Pieris napi-bryoniae* group. These butterflies are all so closely related that in the F_1 crosses Haldane effects are small. In only five or six of all the 69 broods examined for sex-mosaicism did the sex ratio depart significantly from unity. In four of these the females numbered only about half the males; in another there were 28 females to 42 males.

A brood 1952-*b* on the other hand consisted of 15 females and one almost entirely female mosaic (?). While this instance of male deficiency remained an isolated one, only conjecture was possible; at the time it was considered not unlikely that chromosomal males (XX) had been converted into mosaics in which male scaling had almost completely disappeared.

However, in 1957 a new series of crosses between the same two subspecies, the Swiss *bryoniae* Ochsenheimer (locality Engelbergertal) and British *napi* L., was begun. This experiment was designed to test the possibility of maintaining particular *napi* genes in hybrids whose *napi* component was progressively diminished by repeated backcrossing to *bryoniae*. A preliminary account of this work, up to 1959–1960, has been given (Bowden, 1962); subsequent breeding has maintained the chosen *napi* recessive gene to the time of writing, in butterflies calculated to carry in 1964 only $\frac{3}{128}$ of *napi* autosomal material. As so often happens, an experiment designed to decide one question suggested an answer to another: this series provided no less than four broods in which females outnumbered males by between five and ten to one. Many of the few males surviving to the imaginal stage were crippled or weak. Such results imply a sex-limited lethality of variable penetrance.

The relevant figures are given in Table I. Each brood is indicated by an italic or Greek letter preceded by the year in which the eggs were laid. The notation for the subspecific makeup is as in the 1958 paper: B stands for *bryoniae*, N for *napi*, and K for *neobryoniae* Sheljuzhko (Kärnten, Austria). In addition the Greek letter beta is used as shorthand for (BN.B).(B.BN), to simplify notation for the later broods. Placing the female first, the symbols are combined pseudoalgebraically; but an F_3 brood written $(BN)^3$ would be $(BN)^2 \times (BN)^2$, and so differs from $(BN)^2.BN$. Some cultures were of necessity mixed broods from more than one female, though these were always sibs of similar pheno-

TABLE I Sex-differential lethality in ***Pieris*** Hybrids

Parentage ♀ × ♂	No. of ♀♀ used	Hybrid type	Sex chromo-somes*	Brood	No. of imagines ♀		No. of imagines ♂	χ^2 (Yates')	Probability	Remarks
'50-*θ* × '50-*w*	1	BN	C	1951-*γ*	31		31	0	P>0.99	Very few losses
'51-*β* × '51-*γ*	1	(BN)²	E	1951-*ν*	39		43	0.11	0.8>P>0.7	Few larval losses (23 as pupae).
'51-*ν* × '51-*γ*	1	(BN)².BN	E	1952-*b*	15	≫	1 ? ?	11.4	P<0.001	1 mosaic? Most of ca. 80 eggs failed.
'56-*i* × '56-*m''*	1	BN	C	1957-*e*	14		13	0	P>0.99	Few losses.
'57-*e* × '56-*h*	2	BN.B	D	1957-*h*	36	≫	7	18.2	P<0.001	Heavy losses in eggs and very young larvae, 5 of males crippled or weak.
'56-*h* × '57-*e*	1	B.BN	B	1957-*i*	33		24	1.12	0.3>P>0.2	A few losses as eggs and pupae.
'57-*h* × '57-*i*	3	(BN.B) (B.BN)	B	1958-*φ*ⁱ	26	<	48	5.96	0.02>P>0.01	At least 89 losses as eggs and young larvae.
"	2	= *β*	B/A	*φ*ⁱⁱ	4		6	0.10	0.8 > P>0.7	Few losses
'57-*i* × '57-*i*	3	(B.BN)²	B/A	1958-*θ*ⁱ	22		18	0.23	0.7>P>0.5	3 mosaics. At least 34 eggs failed.
"	3	"	"	*θ*ⁱⁱ	2		3	-	-	At least 185 eggs failed.
'58-*φ*ⁱ × '58-*θ*ⁱ	1	*β*.(B.BN)²	B/A	1959-*θ*	2		4	-	-	Many eggs infert. Larval and pupal losses, 101. Disease present.
'58-*t* × '58-*φ*ⁱ	2	B.*β*	B	1959-*φ*ⁱ	12		21	1.94	0.2>P>0.1	1 mosaic) Many losses among larvae
"	2	"	B	*φ*ⁱⁱ	13		16	0.14	0.8>P>0.7	) and pupae.
"	2	"	B/A	*φ*ⁱⁱⁱ	18		14	0.28	0.7>P>0.5	Disease present.
'59-*ε*ᵃ × '59-*φ*ⁱⁱ	2	B.B*β*	B/A	1960-*d*	11		7	0.50	0.5>P>0.3	5 eggs died.
'59-*φ*ⁱ × '59-*φ*ⁱ	1	(B*β*)²	?	1960-*e*	1		-	-	-	16 eggs infertile or dead.
'59-*φ*ⁱⁱ × '59-*φ*ⁱ	1	(B*β*)²	E	1960-*f*ⁱ	10	≫	1	5.82	0.02>P>0.01	32 losses, all stages. Only male, crippled.
"	2	"	E/D	*f*ⁱⁱ	41	≫	5	26.6	P<0.001	37 losses as eggs and young larvae.
"	1	"	B/A	*f*ⁱⁱⁱ	3		2	-	-	14 eggs infertile.
'60-*f*ⁱ × '60-*s*	1	(B*β*)².KN	E	1961-*a*	95	≫	19	49.4	P<0.001	158 eggs recorded; 10 of males crippled etc.
'60-*f*ⁱⁱ × '60-*h*	1	(B*β*)².B	A	1961-*c*ⁱ	12		18	0.83	0.5>P>0.3	From 140 eggs. Losses in egg and pupal stages.
"	1	"	A	*c*ⁱⁱ	15		19	0.26	0.7>P>0.5	Losses in egg and pupal stages.
'61-*o*ⁱ × '61-*o*ⁱⁱ	1	[(B*β*)².B]²	A	1962-*m*	8		10	0.056	0.9>P>0.8	Probably ca. 100 eggs, incl. at least 39 infert. or dead; also larval and pupal losses.
'61-*c*ⁱⁱ × '61-*c*ⁱ	1	[(B*β*)².B]²	A	1962-*n*ⁱ	14		17	0.13	0.8>P>0.7	Many losses, chiefly eggs and larvae.
"	1	"	A	*n*ⁱⁱ	35		43	0.63	0.5>P>0.3	Many larval losses.
"	3	"	A	*n*ⁱⁱⁱ	8		5	0.31	0.7>P>0.5	Many eggs infertile, few other losses.

* At fertilization we may have:
A. XY × XX → XY, XX
B. XY × X'X → XX, X'Y, X'X — where X' is from ***napi***.
C. XY × X'X' → X'Y, X'X
D. X'Y × XX → XY, X'X
E. X'Y × X'X → XY, X'Y, X'X, X'X'

type. From the present point of view this does represent a defect in the design of the experiment, but fortunately it seems to have led to no fatal ambiguity.

The 1961-*a* brood belongs in part to yet another experiment (Bowden, 1963), concerned with the linkage of form "subtalba" with form "sulphurea."

It is thought that only 1959-θ, ϕ^{i}, ϕ^{ii}, and ϕ^{iii} suffered heavy losses from disease irrespective of any special susceptibility. The 1962 and 1963 broods did appear to be affected by general inbreeding depression, which has since been corrected. In most broods the losses, from whatever cause, were sufficient or more than sufficient to cover the sexual imbalance; for example, from 1960-f^{ii} (41 ♀ and 5 ♂) 37 eggs and young larvae were lost (the almost complete absence of males among the more mature larvae of this brood was noticeable at the time). For 1961-*a* (95 ♀ and 19 ♂) only 158 eggs are recorded as laid, but there may in fact have been a few more.

Discussion

Stebbins (1958) points out that if any recessive or semidominant sex-linked gene exists in one species, which produces lethal or sterility effects in combination with autosomal genes of the other, these effects will be covered in the homozygous sex by the corresponding dominant allele in the second X, but will be expressed in the heterozygous sex [female in Lepidoptera] where the dominant gene is absent. Essentially the same particularized explanation of Haldane's rule was earlier given by Muller.

Disturbances of the normal sex ratio, in *Drosophila* and in other animals, have received considerable attention from geneticists. Some of the diverse mechanisms suggested for *Drosophila* species, in which the male is the heterogametic sex, would require modification to be applicable to the Lepidoptera.

Patterson and Stone (1952) mention a gene on the third chromosome of *Drosophila* which reacts to cause death in X-bearing eggs: progenies of any females receiving this gene from their male parent are all male. Another gene, on the second chromosome, is lethal, especially when in the homozygous condition, to diploid females. They also quote a case where females carrying a certain gene had only male progeny, no matter with what kind of male they mated. Again, a dominant mutant in *D. pseudoobscura* changed chromosomal females into intersexes. The original references are given by Patterson and Stone.

Watson (1960) points out that although some of the known instances of abnormal "sex-ratio" condition in *Drosophila* species are due to the action of chromosomal genes, some appear to be cytoplasmic; in the

latter case the condition is transmitted constantly through the female only, over a series of backcrosses to other strains. About 99 percent of the males die, mostly in the embryonic stage; any survivors do not transmit the "sex-ratio" character.

Genic sterility may from the developmental–physiological viewpoint be very similar to hybrid inviability; both may be due to inability to carry out specific metabolic processes—which again is the basis of lethalities due to homozygous genes or deficiencies. A type of male sterility described by Ehrman (1960) in the *D. paulistorum* agg. is therefore worth quoting here. The inter-subspecific hybrids comprise fertile females and sterile males, the sterility depending upon the possession by the male's mother of a mixture of chromosomes from different subspecies: any one foreign chromosome is sufficient and the genotype of the male parent is immaterial.

Some of these mechanisms proposed for *Drosophila* can be ruled out at once in the present case. The cytoplasm is *bryoniae* throughout, for both normal and affected broods: pure cytoplasmic inheritance cannot explain the results. It seems impossible, too, to account for an intermittent decimation of males by any simple autosomal gene that they may themselves carry. Between 1957-*h* and 1960-$f^{i,ii}$ lie two unaffected annual generations, yet the gene cannot be a recessive since far more than a quarter of the males are destroyed at each occurrence.

The brood 1961-*a* forced us to consider in detail the possibility that the constitution of the mother of the brood is alone responsible.

Examining the series of hybrids and backcrosses begun in 1957, we first find the F_1, 1957-*e*, perfectly normal. There is not even a Haldane effect.

The backcrosses, 1957-*h* and *i*, differ. The latter, *i*, is close enough to normal, but *h* shows a deficiency of males that is certainly significant. We can probably neglect minor, chance, genetic differences and assume that the effect is due to subspecific makeup. Broods *h* and *i* are merely reciprocal, but the mother of *h* carried a complete haploid set of *napi* autosomes and a *napi* X, whereas the mother of *i* was pure *bryoniae*. Are we to attribute the sex-ratio effect to the X-chromosome or to a dominant autosomal gene of *napi* origin?

We are unable to eliminate entirely the possibility of an autosomal effect. If, however, the mother of *h* carried such a dominant autosomal gene, she must have passed it to half her daughters, and similarly the father of *i* should have passed the same gene to half his daughters. Nevertheless, the three *h* females jointly responsible for 1958-ϕ^i and the three *i* mothers of 1958-θ^i show no sign of it in their progeny. The very

small broods 1958-ϕ^{ii} and θ^{ii} point in the same direction, but can be neglected.

The alternative hypothesis, that the responsible gene or genes are sex-linked, appears more probable. The mother of the affected 1957-*h* had sex chromosomes X′Y, where X′ is from *napi* (we shall neglect any crossing-over between X and X′; X′ is to be considered as the X carrying the relevant genes originally derived from *napi*). Her sons will have been X′X, but X′X is not itself lethal or sublethal in *bryoniae* cytoplasm, since F_1 hybrid sons of a *bryoniae* female are normal. The inference is that the sons of an X′Y mother are affected, irrespective of their own genotype.

The brood 1958-ϕ^{i} will not have had such a mother, but an XY. Accordingly, the sex ratio ♂/♀ was in fact normal, or even high. The male parent could have been XX or X′X; we must assume that it was X′X and the composition of the brood was then X′Y, XY, X′X, XX.

The broods 1959-$\phi^{i,ii,iii}$ were also normal, as would be expected from the XY *bryoniae* mothers. We must again assume that (at least for 1959-$\phi^{i,ii}$) the males from 1958-ϕ^{i} were once more of X′Y constitution, and the brood composed as in the previous generation.

The broods 1960-$f^{i,ii,iii}$ could thus have been produced by X′Y × XX or X′X or by XY × XX or X′X. On our hypothesis, the results imply that the small 1960-f^{iii} was produced by the second alternative, but that the three females responsible for f^{i} and f^{ii} were all X′Y.

The parents of the earlier mentioned $(B\beta)^2$.KN brood, 1961-*a*, were from 1960-f^{i} and a KN brood 1960-*s*. The female parent can have been X′Y; the male was X′X″, probably very like X′X; in this case the brood is essentially similar to 1960-f^{i}.

Reverting to the main series, the brood 1960-*d*, having a pure *bryoniae* mother, is of normal sex ratio. Broods 1961-$c^{i,ii}$ are from 1960-f^{ii} × *bryoniae*. Here the female parent can have been XY, allowing the normal ratio actually obtained. But if so, the X′ is eliminated from the series, and all later broods must also be normal. The subsequent 1962-*m*, 1962-$n^{i,ii,iii}$ in fact show no deficiency of males; two other broods of that year, being from pure *bryoniae* females, would be expected normal in any event. Two 1963 broods produced only 16 butterflies altogether, but there was no relative deficiency of males.

Thus, results in the 1957 series are consistent with the supposition that females carrying a *napi* X with *bryoniae* Y and *bryoniae* cytoplasm produce the broods in which males are underrepresented. In some cases there is no certainty that a *napi* X was present, though always it may

have been. Unfortunately no "visible" sex-linked genes are yet known in *P. napi*, and the X-chromosome is necessarily unmarked.

We may now return to the earlier brood 1952-*b*, which was entirely, or almost entirely, female. Its makeup was $(BN)^2.BN$, and the mother, from 1951-*v*, must have been produced by $X'Y \times X'X \rightarrow X'Y$, XY, $X'X$, $X'X'$, but in spite of this she belonged to a brood of normal sex ratio. Four similar F_2 hybrid broods from the year 1952 were listed in our 1958 paper and will not be repeated here: all had normal ratio. Unfortunately, a straight F_2 pairing in the 1957 series produced only infertile eggs, so it is not possible to say whether some special circumstance always rules for F_2 hybrids. If this could be granted, we could explain 1952-*b* as from $X'Y \times X'X$.

Seven broods $B.(BN)^2$ in 1953, having XY mothers, would be expected normal; the male parents being $X'X$ and $X'X'$, both $X'Y$ and (in smaller numbers) XY females would be produced. The ten $[B.(BN)^2]^2$ broods obtained by inbreeding could thus have had XY or $X'Y$ mothers. In fact, as the previously published table shows, the three largest broods had subequal sexes, totaling 54 females plus 54 males, while seven small broods yielded 18 females plus two males; there were also a few sexual mosaics. It seems possible, then, that the female parents were of the two genotypes suggested.

Results in the 1951 series also were therefore in accordance with the $X'Y$-mother hypothesis, except that the F_2 hybrids which were included in that series showed a normal sex ratio. It is not clear what special circumstance can rule in the F_2; the brood 1951-*v* was too successful for the easy assumption of a compensating loss of females. We are unwilling to postulate any difference between the stocks used in 1951 and 1957 that would be relevant here. Nor does the autosomal-gene alternative remove the difficulty.

It is clear from Table I that among *napi-bryoniae* hybrid populations other lethal effects, which are not sex-limited, must at times reduce numbers drastically, and perhaps more significantly by their extension to females. A more adequate discussion of the bearing of the sex-ratio effect, as of other phenomena reducing viability and fertility, on the likelihood of successfully continued hybridization in the wild, must be reserved. The *napi* X' may be more, or less, compatible in the genetic environment provided by other *bryoniae* subspecies.

Meanwhile, it appears to be desirable to raise new broods BN.B and $(BN)^2$ using different *napi* stocks. In most $(BN)^2$ broods heavy losses are likely, but a further $(BN)^2.BN$ brood might be obtainable. With the $X'Y$ hypothesis in mind, it should be possible to avoid the improvi-

dence of the accidental elimination of the *napi* X′. Such experiments, employing Jugoslav and Corsican *napi*, were begun in 1964. Results of a reverse experiment, in which *bryoniae* provides the "foreign" X, might also be illuminating.

SUMMARY

Five broods of *Pieris napi–bryoniae* hybrids have been obtained with male numbers about one-fifth to one-tenth of the females, in conflict with Haldane's rule that the heterozygous sex is the more liable to the prejudicial effects of hybridity. Many of the male escapers were weak. In every case the mother of the brood may have carried *napi* X-chromosomal material with *bryoniae* Y and *bryoniae* cytoplasm, and it is suggested that the effect is purely maternal. However, females thus constituted have on occasion produced F_2 hybrid broods of normal sex ratio. Necessary further experiments are in progress.

ACKNOWLEDGMENTS

The author has been greatly helped by the generous supply of living material by Herr G. Hesselbarth of Quakenbrück, Herr L. Leidenbach of Luzern, Dr. F. Benz of Binningen, and Herr Ing. E. Kromer of Bad Vöslau.

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The Lepidopterists' Society
CONSTITUTION AND BY-LAWS

(As amended January 1964)

WHEREAS, The Lepidopterists' Society was formed on May 4, 1947, to promote the scientifically sound and progressive study of Lepidoptera by —

1. publishing a periodical on Lepidoptera.
2. facilitating the exchange of specimens and notes by both the professional worker and the amateur in the field,

AND WHEREAS, it is now proposed to organize said Society in a more formal manner, the following Constitution and By-Laws are hereby adopted by the duly appointed Organization Committee. [1 October 1950]

CONSTITUTION

Article I. NAME

Section 1. The organization shall be known as The Lepidopterists' Society.

Article II. OBJECT

Section 1. It shall be the purpose of the Society to promote internationally the science of lepidopterology in all its branches; to further the scientifically sound and progressive study of Lepidoptera; to publish periodicals and other publications on Lepidoptera; to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures tending to that end, and to facilitate personal intercourse among its members.

Article III. MEMBERSHIP

Section 1. All persons interested in lepidopterology shall be eligible for membership.

Section 2. All individual subscribers to the *Journal* and the *News of the Lepidopterists' Society,* who have paid their current annual dues, shall be deemed members of the Society.

Section 3. The membership of the Society shall consist of four classes — Active, Sustaining, Life, and Honorary Members. All persons who joined the Society before January 1, 1948, shall be designated Charter Members.

Section 4. Application for Active, Sustaining, and Life membership in the Society, received by the Secretary or Treasurer and accompanied by the annual dues for the current year, shall constitute formalization of membership, and no nomination or election to membership shall be necessary. The annual dues shall be fixed by the By-Laws.

Section 5. Any member may become a Life Member upon the payment, at one time, of such sum as shall be fixed by the By-Laws, and shall be exempt from further assessment. He shall receive during his life a subscription to the *Journal* and the *News of the Lepidopterists' Society.* Life Membership fees shall be placed in a permanent Publication Fund.

Section 6. Individuals who have made important contributions to the science of lepidopterology may be elected Honorary Members of the Society. There shall not be more than ten living Honorary Members.

Section 7. Members one year in arrears in the payment of dues shall be dropped from the rolls by the Secretary.

Section 8. The Executive Council may expel any member of the Society for such cause as it may deem sufficient for expulsion. This action may be taken only after unanimous approval by members of the Council. Petition for expulsion shall be presented to the Secretary for presentation to the Council. On expulsion, the departing member shall be refunded all dues paid for the current year. An expelled member may be reinstated by unanimous affirmative vote of the Council.

Article IV. OFFICERS

Section 1. The officers of the Society shall consist of a President, three Vice-Presidents (not more than one of whom shall reside in one country), a Secretary, and a Treasurer, but these last two offices may be filled by the same person.

Section 2. The business and affairs of the Society, not otherwise provided for, shall be controlled by an Executive Council, consisting of the President, three Vice-Presidents, the Secretary, the Treasurer, and six other members of the Society. Action on all amendments to the By-Laws and all appointments and elections by the Executive Council shall be obtained by a canvass by the Secretary of all members of the Council.

Section 3. The Executive Council may appoint one or more Assistant Secretaries or Assistant Treasurers to serve during the pleasure of the Council. The offices of Assistant Secretary and Assistant Treasurer may be filled by the same person.

Section 4. The Executive Council shall have power to make and adopt By-Laws for the conduct of the business and affairs of the Society and for the regulation of its procedure not inconsistent with the terms and provisions of the Constitution.

Article V. ELECTIONS

Section 1. The President shall before the first of July appoint a Nominating Committee who shall nominate one candidate for each elective office to be filled for the ensuing year, and a list thereof shall be published in one of the Society's periodicals or mailed to the members at least sixty days before ballots are mailed by the Secretary. Additional candidates may be nominated by submission to the Secretary of written nominations signed by not less than ten members. Ballots containing all nominations shall be mailed in November of each year, setting forth the officers to be elected and the names of those nominated for each office. If more than one person is nominated for any office, their names shall be arranged alphabetically on the ballot.

Section 2. Election of Officers. All officers shall be elected by ballot. The President and all Vice-Presidents shall be elected for the term of one year, and shall be eligible to succeed themselves once. The Secretary and Treasurer shall be elected for the term of three years and shall be eligible to succeed themselves twice. The six other elective members of the Executive Council shall be elected for the term of three years; two of them shall be replaced each year; these members shall not be eligible to succeed themselves. For each office, the nominee receiving the highest number of ballots shall be elected. Officers shall take office at the beginning of the calendar year for which they are elected.

Section 3. Election of Honorary Members. Honorary Members shall be nominated by the unanimous vote of the members of the Executive Council. The nominee shall be voted on by mail ballot distributed to all members of the Society and reported in one of the Society's periodicals, and must receive 80% of all ballots cast to be elected. Not more than five Honorary Members may be elected at the first annual meeting, and not more than two in any one calendar year.

Article VI. DUTIES OF OFFICERS

Section 1. The President shall preside at all meetings. He shall appoint all committees and be Chairman of the Executive Council and a member *ex officio* of all other committees, except the Editorial Board. He may appoint also delegates to other learned societies, Congresses, and conventions.

Section 2. The First Vice-President shall assume the duties of the President in case of his death, resignation, absence, or disability.

Section 3. In case the President and all Vice-Presidents are absent at a meeting, a temporary Chairman may be chosen by a majority vote; he shall be a member of the Executive Council unless none is present, in which event another member of the Society may be elected.

Section 4. The Secretary shall keep the minutes of the meetings of the Society and of the Executive Council; shall give notice of the meetings of the Society; shall attend to all general correspondence; shall keep all records and files of the Society; shall prepare and distribute ballots; and shall generally perform all services that may be delegated to him.

Section 5. The Assistant Secretary shall assume the duties of the Secretary in

case of the death, resignation, absence, or disability of the Secretary, and shall assist the Secretary as need be.

Section 6. The Treasurer shall receive all monies for the Society and deposit them in the name of the Society in such banking institutions as the Executive Council shall direct. He shall pay therefrom by draft or check all bills and obligations of the Society; he shall keep an account of all monetary transactions and shall exhibit a statement of them when called for by the President or the Executive Council, and shall make a full report for the preceding calendar year at the annual meeting.

Section 7. The Assistant Treasurer shall assume the duties of the Treasurer in case of the death, resignation, absence, or disability of the Treasurer, and shall assist the Treasurer as need be.

Section 8. At the expiration of his term of office, each officer shall deliver to his successor all books, papers, funds, and vouchers belonging to the Society.

Section 9. The Society shall not and may not make any dividend, gift, division, or bonus in money to any of its members.

Article VII. MEETINGS

Section 1. The annual meeting shall be held in affiliation with the International Congress of Entomology or the annual meeting of the American Association for the Advancement of Science, or at such other time and place as the Executive Council may determine. Notice of said meeting shall be given as provided in the By-Laws.

Section 2. Special meetings of the Society may be called by the Secretary upon the written request of the President or ten active members. Such request shall state the purpose for which the meeting is to be called and the time and place where it is to be held. No other business, except that specified in the call, shall be transacted, except by unanimous consent of the members present.

Article VIII. PUBLICATIONS

Section 1. The Society shall publish a periodical to be known as the *"Journal of the Lepidopterists' Society,"* a continuation of *The Lepidopterists' News.* The *Journal* shall be devoted to original papers, literature abstracts, and other matter of permanent record. Each volume shall be issued for a calendar year, and shall be composed of four numbers. In it shall be published a summary of the proceedings of the annual meetings.

Section 2. The Society shall also issue a periodical to be known as *"News of Lepidopterists' Society,"* which shall be devoted primarily to notices by members, lists of new members, announcements of nominations, committee appointments, forthcoming meetings, summaries of the recent field collecting season, and other matter of interest to members but not requiring permanent record. It shall appear at more frequent intervals than the *Journal.* A list of members of the Society shall be issued at least every second year.

Section 3. The Society may issue from time to time serial publications to be known as *"Memoirs of the Lepidopterists' Society"* to contain longer works than are normal for the *Journal* and the *News.* This shall be financed by special funds, not by the annual dues, and shall be sold separately to members, at a lower price than to non-members.

Article IX. EDITORIAL BOARD

Section 1. The publications of the Society shall be under the charge of an Editorial Board, consisting of a Chairman and two other at-large members, the Editor of the *Journal,* the Editor of the *News,* the Editor of the *Memoirs,* and the two Associate Editors of the *Journal.* The Chairman may also be one of the above five editors. It shall determine broad publication policies of the Society not otherwise provided for in the Constitution or the By-Laws. It shall consider potential candidates for editorships and then make recommendations to the Executive Council for appointments of the three Editors.

Section 2. The Chairman of the Editorial Board shall be appointed by the Executive Council for the term of three years, and he may be re-appointed. The Executive Council shall appoint, on recommendation of the Editorial Board, the

three Editors, for terms of three years each; all three Editors may succeed themselves once.

The Associate Editors and other members of the editorial committee of the *Journal* shall be appointed by the *Journal* Editor; their terms shall terminate with his term, but his successor may reappoint any of them.

Editorial committees or staff members of the *News* and the *Memoirs* shall be appointed by the respective Editors, but their terms shall terminate with those of their Editors; they may be reappointed.

Article X. AUDITING COMMITTEE

Section 1. The President shall appoint an Auditing Committee consisting of three members who shall audit the accounts of the Treasurer and render their report to the Secretary before December 31st.

Article XI. LIBRARIAN

Section 1. The Librarian shall be appointed by the Executive Council. The Librarian shall serve for the term of three years, or until his successor shall have been appointed.

Section 2. The Librarian shall have charge of the library of the Society, and of all books, periodicals, reprints, and historical material received by the Society. He may make all necessary rules and regulations for the use of the library, not otherwise provided for in the Constitution or the By-Laws.

Article XII. AMENDMENTS

Section 1. This Constitution may be altered, amended, or repealed by a two-thirds vote of the members voting by mail ballot. Each proposal for amendment must be signed by not less than five members of the Society and submitted to the Secretary who will promptly transmit it to the Editors of the *Journal* and *News*. Each proposed amendment shall be published in one of the Society's periodicals at least three months before the annual ballot is mailed in November.

Section 2. The By-Laws may be altered, amended, or repealed, by a majority vote of the members voting, at any meeting of the Executive Council or in a mail-canvass of the Council by the Secretary. All changes so validated shall be published in one of the Society's periodicals.

BY-LAWS

Article I. DUES

Section 1. Beginning with 1961, the annual dues for active members shall be Six Dollars, U.S.A. ($6.00). Active membership shall include a subscription to the *Journal of the Lepidopterists' Society* and the *News of the Lepidopterists' Society.*

Section 2. The annual dues for sustaining members shall be Fifteen Dollars, U.S.A. ($15.00). Sustaining membership shall include a subscription to the *Journal of the Lepidopterists' Society* and the *News of the Lepidopterists' Society.*

Section 3. Life members shall pay the sum of One Hundred and Twenty-Five Dollars, U.S.A. ($125.00). Each life member shall receive a subscription to the regular society publications during his life.

Section 4. Honorary members shall pay no annual dues, but shall receive a subscription to all publications of the Society.

Section 5. All dues shall be payable on January 1 of each year, and shall be deemed in arrears on March 1 of that year.

Section 6. Publications of the Society shall not be mailed to any member whose dues are in arrears.

Section 7. After 1955 the annual dues shall be waived for the Secretary, the Treasurer, and the Editor of the *Journal,* while they are in office; they shall continue to receive all publications of the Society.

Article II. MEETINGS

Section 1. Notice of all meetings of the Society shall be printed in the *News of the Lepidopterists' Society* at least two months in advance thereof.

Section 2. A majority of members present at an annual meeting, or represented by proxy, shall constitute a quorum for the transaction of business, not otherwise provided for.

NOTICE TO CONTRIBUTORS TO THE *JOURNAL*

Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11" paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal*. Legends of figures and tables should be submitted on separate sheets.

Reprints may be ordered, and at least 25 gratis separates (including any other material published on these pages) will be provided, if requested at the time galley proof is received.

Address correspondence relating to the *Journal* to: Dr. J. A. Powell, 122 Giannini Hall, University of California, Berkeley, Calif., U. S. A.

Material not intended for permanent record, such as notices, current events, anecdotal field experiences, poems, philatelic Lepidoptera, etc. should be sent to the *News* Editor: E. J. Newcomer, 1509 Summitview, Yakima, Wash., U. S. A.

Address remittances and address changes to: George Ehle, 314 Atkins Ave., Lancaster, Penna., U. S. A.

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Volume 20 1966 Number 4

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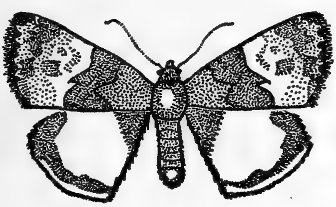

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NICHOLAS S. OBRAZTSOV, 1906–1966

(Complete contents on back cover)

30 November 1966

THE LEPIDOPTERISTS' SOCIETY
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Terms expire Dec. 1968:	P. R. Ehrlich (Stanford, Calif., U. S. A.) C. D. MacNeill (Oakland, Calif., U. S. A.)

and *ex-officio*: the above six elected Officers and the Editor

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

Active Members—annnal dues $6.00 (U. S. A.)
Sustaining Members—annual dues $15.00 (U. S. A.)
Life Members—single sum $125.00 (U. S. A.)

Dues may be paid in Europe to our official agent: E. W. Classey, 353 Hanworth Road, Hampton, Middx., England.

In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is Yale University, Peabody Museum, New Haven, Connecticut. Second class postage paid at Lawrence, Kansas, U. S. A.

Journal of The Lepidopterists' Society

Volume 20 1966 Number 4

DEVASTATION OF YUCATECAN FORESTS, WITH NOTES ON INSECT ABUNDANCE AND FORMATION OF LOCAL CLIMATES

Eduardo C. Welling
Mérida, Yucatán, Mexico

Yucatec is a term which can be applied to aspects of the whole of the Yucatán Peninsula, including parts of southern Mexico, British Honduras, and Guatemala. The peninsula is a district subregion, not only biologically, but geologically and in climate as well. It was once covered with forest from east coast to west and from north to south. This forest was not of the same character before human inhabitation as at present. Apparently the vegetation had been greatly disrupted about 1,000 years ago, and in recent times has staged a major recovery by returning mostly to a climax state. I will comment below on general life sub-zones of the peninsula, their present condition, and probable past history.

The area now occupied by the Yucatán Peninsula was once under a shallow sea. The peninsula was formed mostly by calcareous deposits of marine life. This formation, including emergence from the sea, took place in the northern part of the peninsula, which is remarkably flat, in Pliocene and early Pleistocene times of the late Tertiary and early Quaternary. The southern, undulating portion was formed much earlier, during the Eocene and Oligocene.

The vegetation can be roughly divided into three major zones. The first of these is the thorn forest zone, both evergreen and deciduous, which dominates almost all of the state of Yucatán and the central and northern parts of Campeche. This area has an average yearly rainfall of about 75 cm (30 inches), decreasing from east to west. The trees attain an approximate maximum height of 12 to 15 meters in the climax state. The second zone is the subequatorial or transitional zone which contains different forest types, with an approximate maximum height of 20 to 30 meters in the climax state. This area has from 125 to 200 cm (50–75 inches) of rainfall yearly, and extends over all of Quintana Roo, northern British Honduras, southern Campeche, and certain parts of northern El Petén. The third is the true equatorial zone which flourishes

in central and southern British Honduras and central and southern Petén. Here the rainfall is from 200 to 500 cm (80–200 inches) yearly, and climax forests reach a height of 50 to 70 meters.

Rainfall and average overall height of the forests diminish from south to north. It may be of some significance that this corresponds with the fact that southern portions of the peninsula have been upraised from the sea for a longer time, thereby allowing for the more thorough breakdown of the limestone and the formation of a richer soil. Another possible factor for development of a magnificent forest cover in the south is the proximity to the great mountain ranges of Chiapas and Guatemala, and the distance from the sea. Low coastal areas in the Gulf of Mexico area are usually devoid of luxuriant vegetation where they extend far from mountains.

Both human and natural destructive forces have been influential in greatly decimating the natural forest cover. During the height of the Mayan civilization 800 to 2,000 years ago, it is estimated that there were two million people on the peninsula. Today, with an approximate population of 900,000 in the north that cannot grow the corn it needs, and 100,000 in the south, the peninsula is less densely populated than in the past. It is my belief that impoverishment of the soil due to agriculture was one of the greatest factors contributing to the downfall of the ancient civilization. When the great Mayan migrations from the south arrived on the peninsula the people found a virgin soil to work; later the soil could not sustain two million people. With the decline of abundance of food, the population began to dwindle. Large areas were abandoned and consequently reverted to climax forest, most of which was not disturbed again until the last 100 or 200 years. Subsequent to the Mayan civilization, the bulk of the population has been concentrated in northern Campeche and Yucatán. The soil is now failing again and migrations are taking place into southern Campeche and Quintana Roo. The dispersal of people and the effect of cultivation on the land in centuries past has been a much more complicated process.

With the bulk of the Mayan populace residing in Yucatán and northern Campeche, which is the territory occupied by the thorn forest, this forest has suffered greatly. Virgin or climax stands are almost nonexistent, especially in western Yucatán. However, fortunately the area has a limestone subsoil or base, and following destruction, such as by fire, the same trees and shrubs spring up the following year. On a nonlimestone base thick grasses frequently cover the soil immediately after destruction of the forest, thus creating great difficulties for the reestablishment of primitive forest species. Therefore, there is no great difficulty collecting insects peculiar to the thorn forest, along with other

wide-ranging unspecialized species in the subregion, even if the primary forest has been completely exploited and destroyed, as the larval food-plants of the phytophagous insect fauna can be found everywhere in varying stages of development. This is most fortunate since otherwise a greater poverty of insects would exist than there does at present.

The presence of some rather local forms gives evidence that the thorn forest in certain areas is natural, not artificially caused. As examples I give *Papilio rogeri* Boisduval, a curious and unusually stable population of *Chlosyne lacinia* Geyer, and *Anaea tehuana* Hall. Except for the first-mentioned species, these are found in only limited spots in the southern area.

The great impoverishment of the western part of Yucatán is partially due to the extensive planting of henequen (*Agave* sp.) for fiber industries. Rains from the east frequently cease to advance on approaching the cleared area, which has to be continually cut and clean; whereas the rains develop again further west of Mérida, where no henequen has been planted. This has produced a "local climate" of extreme heat and dryness in the environs of Mérida. Here certain insects are scarce and appear much later than in the eastern parts of the thorn forests, and the number of species is greatly reduced. For example, in nearly 10 years, I have never seen *Morpho peleides* Koll. or *Caligo memnon* Feld. in the western part of the state, while they are always found in the eastern part.

The subequatorial zone has a richer insect fauna than that of the thorn forest areas of Yucatán and Campeche. Until recently many wide-spread species peculiar to more open country such as certain *Papilio, Euptoieta, Zerene,* and *Phoebis* were practically absent. Upon the recent clearing of patches in the forests by people migrating from northern parts of the peninsula these open-country species have quickly become established. The above is also true for some endemic forms associated with the thorn forest. The same establishment has been noted with certain birds and plants. Exploitation of the forests for lumber has been rather intensive in south central Campeche and southern Quintana Roo. The great hurricane of 1955 that devastated Chetumal, Quintana Roo, and Corozal, British Honduras, and most of the forest in a 100-km radius north and south of these towns and quite the same distance into the interior, was followed by two years of extreme aridity perhaps in part due to the lack of the tall forest which formerly served to cool the air and to induce rain. In 1957 huge fires swept over southern Quintana Roo, and the ground was left completely bare. Several prefire but post-hurricane species of butterflies, like *Eueides aliphera* Godt., *Papilio torquatus* Cram., and some *Euselasia* spp., are now absent there. Thus,

the character of the fauna has changed and the rainfall has declined. Returning to former luxuriance will take a long time.

Central and northern Quintana Roo are still magnificently forested. There has been little human influence on these forests which were fortunate to escape the terrible 1931, 1955, and 1961 hurricanes. The lack of mahogany in the northern part of the territory has also helped them remain mostly unchanged. Here collecting is magnificent in season, and the best collecting can be experienced beginning in late May, in comparison with August in western Yucatán or late June in eastern Yucatán. During the rainy season it may rain in torrents twice daily, in midmorning and all afternoon, in comparison with once daily beginning about 4:00 P.M. in western Yucatán, or once daily about 1:00 or 2:00 P.M. in the eastern part of the same state.

The great equatorial forests present another aspect altogether. These forests appear to be outside the limits of the true Yucatecan life zone, which is characterized by a flora and fauna adapted to the limestone base, because other geological features are clearly seen in some areas where this luxuriant forest exists, especially in southern British Honduras and southeastern Petén. Still, in south central and southwestern Petén, one can find limestone subsoil under meters of fine, rich top-soil. This equatorial zone, of essentially the same character as the wetter forests that spread northward on the Atlantic side of the mountains from the equator, is a zone of frequent streams and rivers, deep soils, an immense yearly rainfall, and a fantastic insect fauna.

The history of natural and human destruction of the forest is not so well documented as in thorn forest areas. Apparently, the Mayans inhabited this region and had destroyed a part of the vegetation with great difficulty. Probably the damage was not as extensive as in the subequatorial or thorn forest zones, as the clearing of the giant tree forests was not as easily done and excessive rainfall in some limited areas may not have been as ideal for growing corn. The English have been exploiting the forests in British Honduras for nearly 300 years, but still, before the terrible 1961 hurricane, there were great stands of mahogany and other forest giants there. Most of the cultivation has been along the rivers, and the interior part of the country is scarcely populated. In British Honduras cultivation is more stable and not so nomadic as in Yucatán, Campeche, and Quintana Roo, where corn is planted after felling the forest, and then abandoned after two years. All this has helped to protect the equatorial forest to a degree. Also of importance is the fact that no species of tree occurs in pure stands, the forest complex being composed of many species in a relatively small area. During lumbering, only certain trees are taken out here and there,

leaving most of the forest intact. Further inland, in El Petén, no way has been found to take fine woods out economically due to the lack of roads and harbors. Some wood has been floated down the Usumacinta River into Mexican territory, but the treacherous nature of the river in the interior prohibits large-scale forestry work there. The lack of other resources in these areas has made large-scale development and opening of this country unfeasible.

Recently, the equatorial forests in central and south central British Honduras have suffered a terrible disaster due to the 1961 hurricane, which laid waste to hundreds of square kilometers of forest. It has been calculated that it will take at least a century for these forests to attain their former magnificence, providing the rainfall does not diminish. Fortunately, most of the forests which were destroyed are on elevated land, where the elevation will help to sustain the usual precipitation. The forests of El Petén and Chikibul Forest on the western side of the Maya Mountains in British Honduras have escaped hurricane damage. Collecting in the damaged area in the Stann Creek Valley of British Honduras has indicated no remarkable reduction in the insect population following the hurricane; however, the bird population has suffered somewhat and I believe many species dependent upon a heavy forest canopy have migrated to the remaining forest country farther west. This may help to explain the continued abundance of insects in the Stann Creek Valley. The wetness of the region has prevented forest fires in that zone and has helped preserve what is left of the forest. Forest fires raged all through the devastated subequatorial forest areas of British Honduras during early 1963 and 1964. It is hard to collect Ithomiids and other shade-loving butterflies there, since they are usually seen in flight, seemingly searching for a shaded place; nevertheless, they are still present, concentrating in places where there are still a few trees left. The local people told me that in 1962, immediately after the hurricane, butterflies and other insects were very abundant, and I hope that this will be the case until the forest has reestablished itself. Collecting in 1964 and early 1965 also afforded excellent results. It is encouraging to see the British Forestry Department making efforts to prevent further destruction to these forested areas.

In spite of the great damage done to peninsular forests, collecting is still superb at most localities in season. I have in my collection about 720 species of butterflies from the Yucatecan area, and suspect that there are at least another 150 within the limits of the peninsula, an area of about 200,000 square kilometers, approximately 80,000 square miles, or the equivalent of the states of New York, New Jersey, and Pennsylvania combined.

BOOK REVIEW

PESTS OF HEVEA PLANTATIONS IN MALAYA, by B. Shripathi Rao and Hoh Choo Chuan, pp. 1–97, 37 with full-page colour figures, Kuala Lumpur, 1965. (Printed at the Kynoch Press, Birmingham, England.)

The book represents an excellently executed iconography of pests of the rubber tree and other cultivated plants associated with it, viz., the so-called "ground covers." The full-page colourplates are after water colours by the second author, while the explanatory text on the opposite page is by the first author.

The plates are arranged in the sequence of orders of the pests, each referring to a group of pests causing similar injury, e.g., bark-feeding Lepidoptera, flower-feeding caterpillars, root-feeding grubs, etc.

The foreword explains the intention of the volume thus: ". . . a comprehensive treatise comparable in its intention with Mr. Roger N. Hilton's *Maladies of Hevea in Malay*. . . . It enables the planter to identify the creatures that he encounters and to obtain a succinct account of the significance of each. Also included are a number of creatures which are not at all damaging, yet liable to be mistaken for pests, and others which are beneficial."

The book is divided in two parts. The first is a general account of the five major groups of pests, nematodes, insects, mites, molluscs, and mammals. The second, by far larger, part contains the above-mentioned fine colourplates of the pests, their development stages, parasites, and the aspect of the injury, with the text each time opposite the plate.

On the whole, *Hevea* is not subject to disastrous pest attacks, probably because wounds are filled by latex which helps them to heal quickly; on the other hand these pests deserve attention nevertheless, as the rubber tree is the most important crop of Malaya, occupying not less than 65 percent of the cultivated area and 12 percent of the entire country. The herbaceous "ground cover" often is subject to much more severe injury by some pests, which afterwards move to the rubber plants themselves.

This book is of considerable interest not only for the rubber planter for whom it is chiefly intended, but also for the general entomologist, because some of the fine coloured illustrations depict species, stages, or characteristic shelters, etc., which never have been illustrated before.

A. DIAKONOFF, *Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands*

ELECTROPHORETIC VARIATION IN ESTERASES OF *COLIAS EURYTHEME* (PIERIDAE)

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and Dept. Biology, Wesleyan University, Middletown, Connecticut

In recent years, starch gel electrophoresis (Smithies, 1955) has been used to separate multiple molecular forms of enzymes (isozymes—Markert & Møller, 1959) in many plant and animal species. In insects, isozymes of fruit flies of the genus *Drosophila* have received particular attention. The genetics of electrophoretic variation in esterases has been investigated in laboratory strains of *D. melanogaster* Meigen (Wright, 1963; Beckman & Johnson, 1964a; Johnson, 1964). Frequency differences in the alleles controlling esterase variants in *D. ananassae* Doleschall have been found in Samoan island populations (Johnson *et al.*, 1966a). The relative constancy of esterase patterns within species and pattern differences between species has been applied in broad taxonomic comparisons among *Drosophila* species (Johnson *et al.*, 1966b).

In Lepidoptera, the inheritance of esterase variation has been studied in the domesticated silkworm, *Bombyx mori* Linnaeus (Eguchi *et al.*, 1965). The present report is a preliminary account of esterase polymorphism in natural populations of one species of sulfur butterfly, *Colias eurytheme* Boisduval.

Materials and Methods

The 140 adults of *C. eurytheme* used in this study were collected in Austin and San Antonio, Texas, from early May to early June, 1966 (Table I). Most (127) were caught in eastern Austin at two localities, one mile apart: Area 1 at the intersection of Chartwell and Lovell drives, and Area 2 at the intersection of Berkman and Broadmoor drives. Both areas were predominantly open, greatly disturbed, and grown over with weeds and grasses. The remaining specimens (13) were caught in disturbed, weedy, open oak–mesquite woodland near Salado Creek to the east of U. S. highway 281 in northern San Antonio. Although *C. eurytheme* was fairly common in the beginning of the sampling period, it became rare toward the end and apparently disappeared by mid-June.

As a rule, live specimens were used and immobilized by pinching the thorax immediately before homogenization; but 13 living specimens were frozen and were satisfactorily electrophoresed at later dates (Table I). To test for esterase activity, butterfly tissues were homogenized by a procedure devised for single specimens of *Drosophila* (Johnson, 1966).

TABLE I

TEXAS SPECIMENS OF *COLIAS EURYTHEME* ANALYZED BY ELECTROPHORESIS

Locality	Date Collected	No. of Specimens Electrophoresed	
		Males	Females
Austin: Area 1	May 7	6	
	May 10	35[1]	
	May 14	42[2]	8
	May 25	26	1
	May 30	1	
Austin: Area 2	May 28		1
	May 29		1
	May 31	4	1
	June 5		1
San Antonio	May 22	10	3
		124	16

[1] Eleven of these males frozen; electrophoresed on May 23.
[2] Two of these males frozen; electrophoresed on June 3.

But, because of the comparatively large size of the butterflies, the antennae, legs, or a small section of body were routinely used, instead of whole individuals. After homogenization, the slurry was absorbed in filter paper rectangles which were then inserted into a vertical slot cut in the starch gel. Starch gel electrophoresis was performed horizontally, with a discontinuous system of buffers (Poulik, 1957), for 2.5 hours at a gradient of 20 volts per cm. After electrophoresis, the gels were cut horizontally and the bottom slice stained for esterase activity with α-naphthyl acetate (substrate) and Fast Blue RR salt (dye-coupler) (cf. Beckman & Johnson, 1964a).

RESULTS AND DISCUSSION

Although comparison of antennae, eyes, remainder of head, legs, and thick serial sections of thorax and abdomen revealed some esterase pattern differences, four well-separated esterase zones occurred generally. Observations reported in this paper are based on examination of esterase patterns obtained from mid-abdominal sections of all specimens studied. Individual variation in two of the above-mentioned esterase zones (here called EST C and EST E) was conspicuous in both the Austin and San Antonio samples. Less variation appeared in the other zones.

Figure 1 shows the nature of the electrophoretic variation in zone C. At any one or two of three locations in the gel, either a single or double

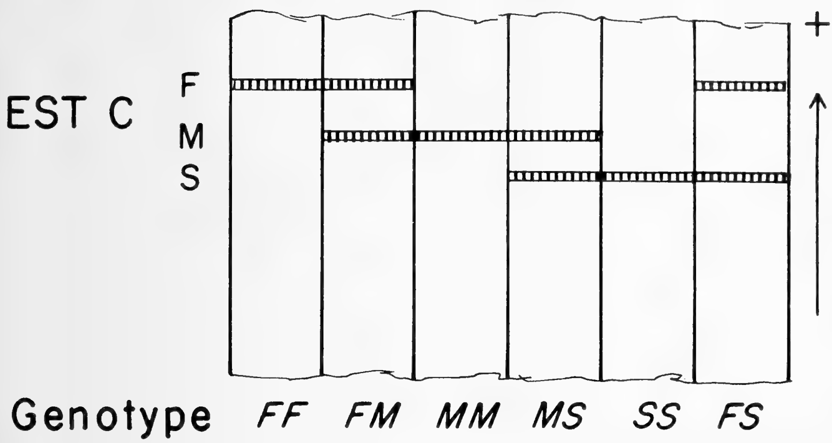

Fig. 1. Part of a gel showing electrophoretic variants in the Esterase C zone. Three presumed alleles, *F*, *M*, and S, lead to the production of a single enzyme band when homozygous and a double band when heterozygous. The arrow indicates direction of migration.

band, respectively, was observed in most individuals. This is interpreted as the expression of a tri-allelic system in which the enzyme of fastest mobility is controlled by the allele *Est* C^F of the structural gene *Est C*, and the enzymes of intermediate and slowest mobilities are controlled by alleles *Est* C^M and *Est* C^S. A presumed fourth allele occurred in a few individuals.

A diagrammatic representation of electrophoretic variation in zone E is presented in Figure 2. The presumed homozygotes show a single band, as in EST C, but the presumed heterozygotes show three bands—a band of intermediate mobility in addition to the parental bands. A similar heterozygous pattern has been observed in alkaline phosphatase from *Drosophila* larvae (Beckman & Johnson, 1964b). This type of pattern suggests at least a dimeric active molecule, with the parental bands resulting from combination of like subunits and the hybrid band from unlike subunits. With synthesis of equal numbers, and with random combination of the subunits, a 1 : 2 : 1 (parental : hybrid : parental) distribution of enzymes is expected in heterozygotes. If dimers are equally active, the band densities should follow this distribution; but such a distribution was found to be uncommon upon examination of the presumed heterozygotes. Rather, the presumed hybrid band alone, or, in other cases, both one presumed parental band and the hybrid band were sometimes stained lightly relative to the remainder of the pattern, suggesting unequal rates of synthesis or preferential dimerizing of the subunits.

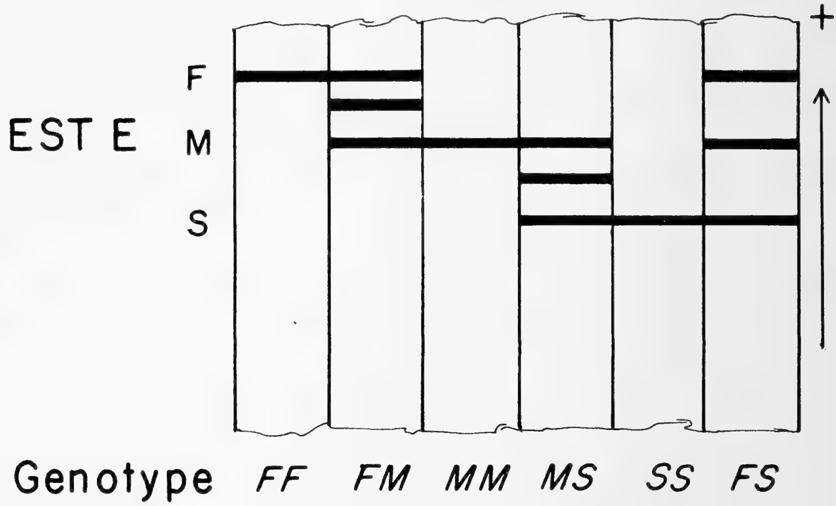

Fig. 2. Part of a gel showing some of the variants in the Esterase E zone. Enzyme bands produced by three alleles (*F*, *M*, and *S*) are pictured in presumed homozygous and heterozygous condition. Heterozygotes have a band of intermediate mobility in addition to the parental bands. The arrow indicates direction of migration.

A striking feature of the variation in EST E is the very large number of apparent alleles. Thirteen distinct parental band positions have been identified in the Austin sample, indicating at least as many alleles. (Only three of the positions appear in Fig. 2.) The small San Antonio sample is also highly variable and includes at least one allele not represented in the Austin sample. At Austin, 77 percent of the individuals are apparently heterozygous for the EST E system; at San Antonio, 83 percent. This large amount of genetic variability, together with differences in rates of synthesis or combination of subunits and/or differences in specificity and activity of the dimeric molecules which may exist, perhaps reflects adaptive flexibility at the molecular level.

A hereditary basis for the variation of EST C and EST E is supported by a partially completed genetic analysis which will be reported elsewhere. A modifier locus may be involved in the expression of the EST E phenotype.

Acknowledgments

We are indebted to Drs. Wilson S. Stone and Robert K. Selander for providing space in their laboratories for this investigation and to Carmen G. Kanapi, Cynthia Greer, and Susan Rockwood for technical assistance. Roy O. Kendall aided in gathering the San Antonio sample. R. K. Selander read the manuscript and made helpful suggestions. This work

was supported, in part, by Public Health Service Research Grant No. GM 11609 to W. S. Stone and M. R. Wheeler and Training Grant Nos. 2T1-GM-337-06 and GM 00337-07 to R. P. Wagner *et al.*, from the National Institutes of Health.

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INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

A.(n.s.)75

ANNOUNCEMENT

Required six-months' public notice is given on the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names, listed by Case Number (see *Bull. zool. Nomencl.* 23, pt. 4, 14 October 1966):

1742. Type-species for *Cosmopterix* Hübner, 1825 (Lepidoptera)
1745. Suppression of *Macrochoeta* Macquart, 1851 (Diptera)
1747. Emendation of STENOPODINAE Stål, 1859, to STENOPODAINAE (Hemiptera)
1748. Suppression of *Scoptes* Hübner, [1819] (Lepidoptera)
1758. Type-species for *Neolycaena* de Nicéville, 1890 (Lepidoptera)

1760. Suppression of *Cellia errabunda* Swellengrebel, 1925 (Diptera)
1762. Type-species for *Enithares* Spinola, 1837 (Hemiptera)

Comments should be sent in duplicate, citing Case Number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W.7, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature.*

W. E. CHINA, *Assistant Secretary*

A POSSIBLE RECORD FOR THE OCCURRENCE OF *CALLOPHRYS* (*XAMIA*) *XAMI* (LYCAENIDAE) IN CALIFORNIA

A female specimen of *Callophrys* (*Xamia*) *xami* (Reakirt) is contained in the collections of the American Museum of Natural History, New York. The accompanying labels bear the following information: Providence Mtns., San Bernardino Co., Calif., IV-5-34, collected by G. H. & J. L. Sperry.

This record would appear to represent a considerable northwest extension of the species' distribution as stated by Clench (1961). I think that the following points lend to the credibility of this record: (1) The Sperrys were noted for the reliability of their collection data, (2) a possible food plant, *Dudleya* (*Dudleya*) *saxosa* (Jones) Britt. & Rose *aloides* (Rose) Moran is found in the Providence Mountains (Munz and Keck, 1959; Uhl and Moran, 1953). Ziegler and Escalante (1964) reported *Echeveria* (*Euecheveria*) *gibbiflora* De Candolle and *Sedum* (*Pachysedum*) *allantoides* Rose, both members of the Crassulaceae, as food plants of *xami* in Mexico, D.F., (3) The date of capture is within the known flight period of this species as defined by Clench and Ziegler and Escalante, and (4) Three other species of Theclini known to occur in the range were collected at the same approximate time by the Sperrys in 1934.

I wish to thank F. H. Rindge for allowing me to examine specimens in the American Museum of Natural History.

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PAUL A. OPLER, *University of California, Berkeley*

THE LARVA AND PUPA OF *ORTHOSIA HIBISCI QUINQUEFASCIATA* (NOCTUIDAE)

John Adams Comstock and Christopher Henne
Del Mar, and Pearblossom, California

In the group of moths listed by McDunnough (1938) under the genus *Orthosia* and in the *insciens–hibisci–quinquefasciata* complex, in particular, there has been much taxonomic juggling in past years by various authors. Along with this, there has been comparatively little life history work, and still less illustrating of the early stages.

The most helpful published note is that of William T. M. Forbes (1954) in which he speaks of the larva of *Orthosia hibisci* as one of the notorious "Green Fruit-worms," and gives a brief description of the larva. He pointed out that *hibisci* is not the typical insect, but is a variation of the normal form, *insciens.*

The form which seems predominant on the West Coast is *quinquefasciata,* a subspecies which was described by Smith in 1909 (Jour. N. Y. Ent. Soc., 17: 65). Later, Smith (1910), referring to its habitat, said, "I have at present four males and two females from Wellington and Vancouver, B. C., and Pullman, Washington."

Hampson (1905) lists *hibisci* Guen., and *insciens* Wlk., under *Monima alia* Guen., which he pictures in color on Plate 90, fig. 29.

S. E. Crumb (1956) described the mature larva in some detail, and stated that "no differences have been found between larvae of eastern *hibisci* and western *hibisci* var. *quinquefasciata* Smith." His comment on food plants was "a very general feeder, principally on woody plants." Other authors specifically mention *Quercus, Salix,* and *Prunus.* Prentice (1962) recorded numerous hosts for *h. hibisci,* with highest number of collections from *Populus, Salix,* and *Betula.*

A mature larva of this species was collected in the San Gabriel Mountain, northwest of Jackson Lake, Los Angeles County, June 10, 1964, elevation 5,800 ft. It was feeding on *Alnus rhombifolia* Nutt. An adult was reared from this larva, making possible the identification, and the following illustrations and descriptions.

Larva

Final instar (Fig. 1 A): Length 35 mm. Greatest width, 5 mm. Head width 3 mm; glistening yellow–green. Ocelli, lower two or three black, remainder translucent. Labrum and antennae nearly white. Tips of mandibles brown.

Body ground color, alder-leaf green. First cervical segment, anterior margin white. A conspicuous middorsal longitudinal white band, a narrow longitudinal subdorsal white stripe, a wide white band just above the spiracles. Area between these bands and stripes profusely sprinkled with small white dots, as is subspiracular region, including venter.

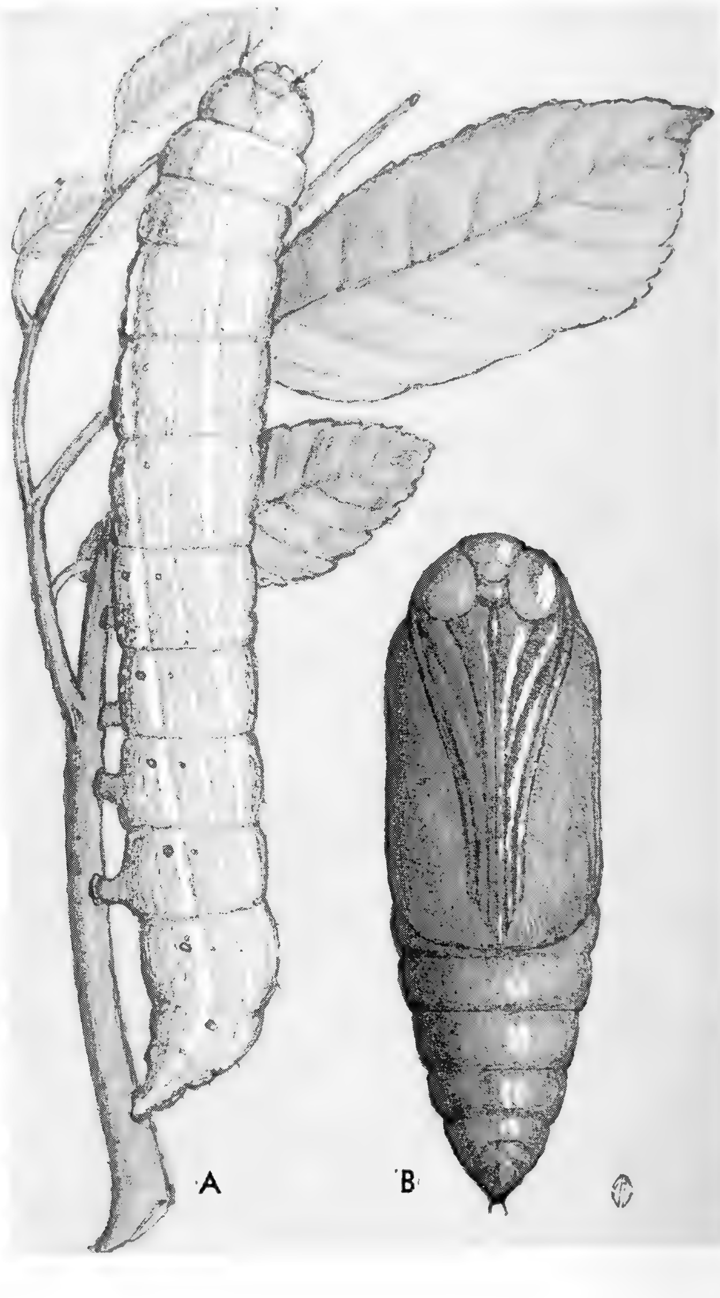

Fig. 1. *Orthosia hibisci quinquefasciata* Smith; A, mature larva; B, pupa, ventral aspect. Drawing by J. A. Comstock.

Legs translucent light green. Prolegs concolorous with body. Crochets tinged with pink. Spiracles light tan, narrowly rimmed with brown. All spiracles located along the lower edge of the white surpraspiracular band except the last caudal, which is superior to the band.

Setae short and colorless.

Pupa

(Fig. 1 B) Length, 15.5 mm. Greatest width through middle of thorax, 5.3 mm. Eyes smooth, prominent. Maxillae reaching to wing margins. Metathoracic leg extending 0.5 mm short of prothoracic, antennae still shorter. Abdomen tapering to a point, from which a pair of short straight spicules protrude. Spiracles, small, concolorous with body, their centers slightly protruding, margins recessed.

Pupa nearly black, abdominal segments and thoracic appendages tinged with red–brown. Surface texture smooth and glistening over abdominal areas, very finely ridged or furrowed over most of the thorax and wings.

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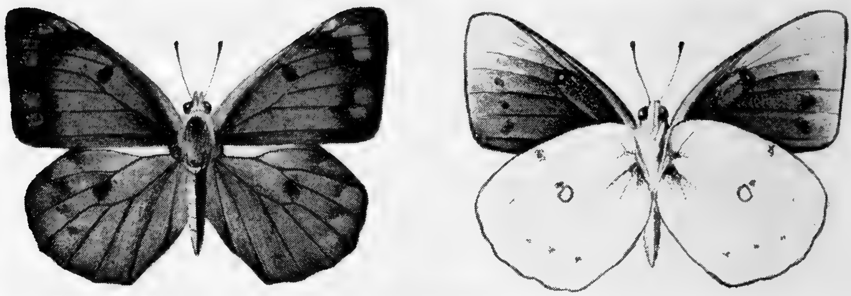
A MELANIC FEMALE OF *COLIAS EURYTHEME* (PIERIDAE)

The capture of a black *Colias* is apt to be a once-in-a-lifetime experience. The collector knows almost instinctively that he has taken a phenomenal prize among butterflies. A melanic female of *Colias eurytheme* Boisduval was taken on August 7, 1965, in the front yard of an Ottawa, Kansas home. The butterfly was taken while in company with *Agraulis vanillae* (Linn.) and *Phoebis sennae eubule* (Linn.), but no other *Colias* were in evidence in the vicinity.

It will be noted from the illustration made from the specimen that the familiar black pattern edging so characteristic of both *eurytheme* and *philodice* is much in evidence, but the ground color of the upper surfaces is an even smoky gray on both pairs of wings. The deep orange hindwing cell spot of a normal female is, in this case, solid black. The veins are heavy and black. The lower surfaces are even more dramatically unusual. The basal portion of the forewing is a dark smoky blue–gray with black granules fading out toward the margin to a pale greenish yellow. In contrast to the black area of the forewing, the hindwings



Melanic female *Colias eurytheme* Boisduval, Ottawa, Kansas, August 7, 1965. Left: upperside; right: underside. Drawing by W. H. Howe.

are a uniform pale yellowish green. As shown on the illustration the outer pink fringe, a characteristic of normal specimens, is much in evidence.

A "black" female is not really black, at least not in this case or in the other individuals I have seen. So few collections contain these extreme forms that there are few available for comparison. The only other "black" female I have seen was taken by Mr. Jack Newlin of Prairie Village, Kansas, in July, 1956. I made a color painting of this specimen at the Newlin home on January 1, 1963. This specimen lacked any black maculation whatever. It was smoky gray–brown throughout. It was a faded and badly rubbed specimen. The outer pink fringe was almost completely worn away.

In contrast, my Ottawa specimen was perfect and fresh and is a perfect example of this phenomenon that exists but is seldom observed.
—WILLIAM H. HOWE, 822 East 11th St., Ottawa, Kansas.

RECORD OF *EUMAEUS ATALA* (LYCAENIDAE) FROM THE FLORIDA KEYS

In view of the extreme rarity of *Eumaeus atala florida* (Röber) in recent years (see Rawson, Jour. Lepid. Soc., 15(4): 237–244, 1962), the capture of a single specimen on 5 June 1960 may be of some interest. This male, in fine condition, was visiting unidentified flowers at a motel in the town of Key Largo on Key Largo, Florida. It is presently in the author's collection. No other individuals were observed, and it is not known if *Zamia* was growing in the immediate vicinity.

RICHARD S. FUNK, *3025 Del Mar Ave., Yuma, Arizona.*

SOME PROPERTIES OF CUTICULAR MATERIALS (SILK, PUPAL CASE, AND WING MEMBRANE) OF *PIERIS RAPAE*

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Insect silk is considered to be a cuticular substance (Richards, 1953), and the adult wing is described as largely cuticular (Du Porte, 1959). Within the limits of relatively simple experimental techniques, some observations were made on these materials as well as on the pupal case left behind on eclosion. Particular attention was given the silk, for chemical information is said to be limited almost entirely to silk produced by the *Bombyx mori* larva (Richards, 1953).

Physical form and properties

Silk: *Pieris rapae* larvae can spin silk threads immediately after hatching, but the silk studied was that produced by the mature larva in preparation for pupation. This appears in the form of a pupal girth by which the chrysalis is suspended and a silken mat (including a button of silk at the anal end of the pupa).

The girth is approximately 23–27 microns in diameter and consists of about 9–14 individual filaments approximately 4–6 microns in diameter (vs. 11 microns observed for a monofilament isolated from a commercial silk thread; Whewell (1941) specifies a diameter of 13 microns for Italian silk and 7.8 for Canton silk). The tensile strengths of a single filament and of a whole girth were measured by suspending a cardboard cone by the filament or girth, slowly sprinkling salt into the cone until failure occurred, and weighing the final load applied. The girth (taking diameter at 25 microns) failed at a load of 7.58 grams to give a calculated tensile strength of 22,000 lb./in.^{2}; a lower value than for monofilament would be expected because several strands were involved and unequal tension would give an effective tensile strength lower than the theoretical combined strength. In accord with this, a single filament (5 microns diameter, breaking load 0.792 grams) was calculated to have a tensile strength of 58,000 lb./in.^{2} A single filament of commercial silk (11 microns, 3.476 grams) gave 52,000 lb./in.^{2}; values of 45,000 to 83,000 have been reported (Billmeyer, 1962). The above values are only approximate, of course, partly because of uncertainty in the cross-sectional area, but they do indicate that the *Pieris rapae* girth filaments are of the same order of magnitude in strength as *Bombyx mori* silk (and presumably consist of essentially the same fibroin).

Fig. 1. Silken mat spun by larva of *Pieris rapae* (L.) prior to pupation; magnified 300 times.

Commercial silk is roughly triangular in cross section (Mark, 1951) while a *Pieris rapae* girth filament was observed to vary from about 4 to 6 microns over a distance of 5 millimeters and so could be roughly oval, triangular, or of other noncircular form in cross section.

The silken mat weighs about 0.17 milligrams (average for 10 mats) and can be peeled from gauze against which the pupa was suspended. The mat consists of fine filaments (about 3.2 microns diameter) coated and glued together with what presumably is sericin or "silk gum" (see Figure 1). Assuming a specific gravity of 1.34 (Mark (1951) gives 1.30–1.37 for raw silk) and a fiber diameter of 3.2 microns, a length of 17 yards was calculated, but this figure would be much reduced by correcting for the gum. In fact, it was very roughly estimated on the basis of Figure 1 (assumed to be representative of the whole mat) that the length is about 6 yards. In contrast to this, the *Bombyx mori* larva produces up to 4,000 yards of silk, of which up to 1,200 yards can be reeled (Whewell, 1941). It is concluded that at least part of the *Pieris rapae* silk may equal that of the silkworm in quality (at least in regard to strength); but since no cocoon is produced by *Pieris,* the quantity (length) is perhaps 0.25% of the silkworm's output.

Sericin is said to be soluble in hot water (Whewell, 1941), and it may be removed by heating with an aqueous solution of soap and ammonia

Fig. 2. Silken mat spun by *Pieris rapae* (L.) prior to pupation, shown after treatment in boiling solution of soap and ammonia; magnified 200 times.

without injuring the fibroin (Hayes, 1954). Mats (4.3 milligrams) were heated in water (1.9 ml.) at 95–100° C. for two hours, and the silk was recovered and dried (85–90° C., less than 1 inch Hg pressure, one hour) to give a matted, paperlike sheet (2.9 milligrams, 68% recovery). Raw *Bombyx mori* silk is said to consist of 11% water, 66% fibroin (which happens to agree with the 68% recovery above), 22% sericin, and 1% mineral and coloring matters (Whewell, 1941). In a more rigorous treatment, mats (4.7 milligrams) were boiled with a solution of 0.3 grams potassium stearate and 4.4 grams 28–30% aqueous ammonia in 20 ml. deionized water for 80 minutes. The visible silk was isolated, washed with water, and vacuum-dried to give a low recovery (0.4 milligrams, 9%); the remainder was solubilized or dispersed. The purified silk from another run was dried on microscope slides and stained with 0.9% aqueous Rhodamine B or Malachite Green solutions, which dyed commercial silk also. Silk, like other protein fibers, has an affinity for members of nearly all classes of dyes (Clayton, 1940) and is combined with readily by basic dyes (Hayes, 1954). Figure 2 is a photomicrograph of the Malachite Green-dyed sample. The complete removal of the gummy material is apparent.

The refractive index of *Pieris rapae* silk (mats) and commercial silk thread is approximately the same; both became almost invisible in a

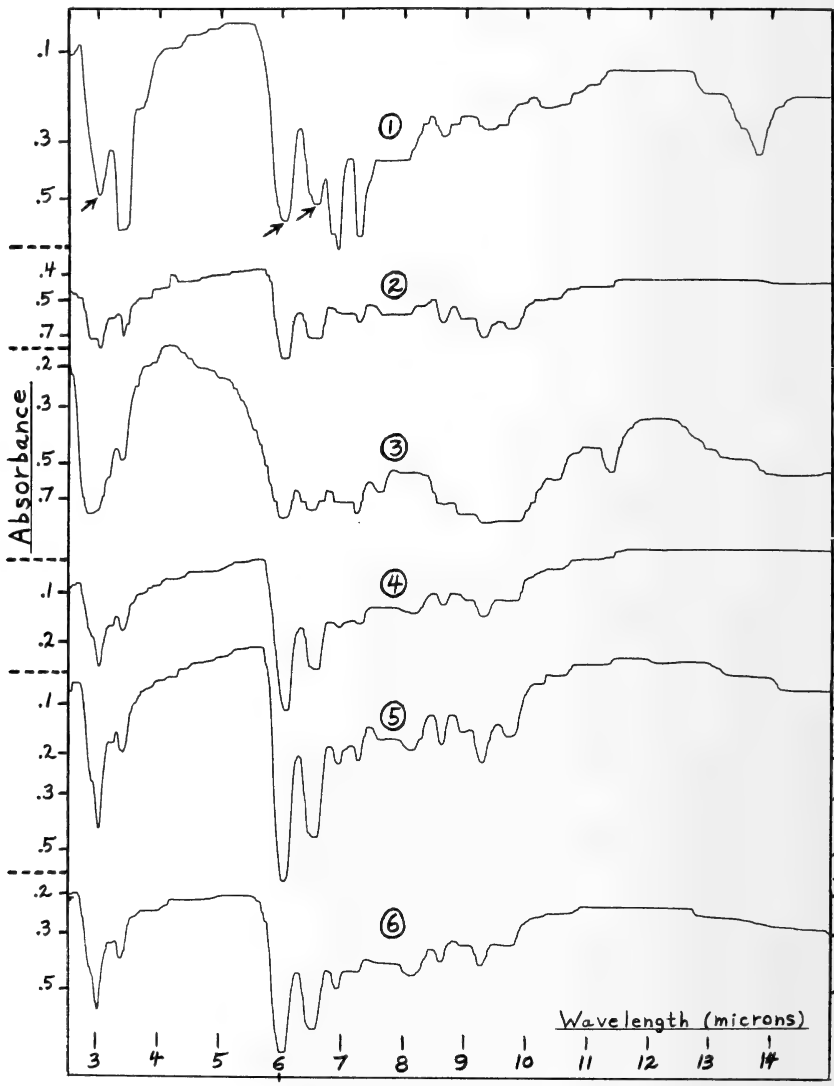

Fig. 3. Spectra obtained with an Infracord Model 137B spectrophotometer (twelve-minute scan). The pupal case and wings (descaled by rubbing) were mounted over holes in cardboards and placed in the sample beam. 1, *Pieris rapae* (L.), silken mat wetted with Nujol (Paraffin oil) between NaCl plates with Nujol between NaCl plates in the reference beam. 2, *P. rapae*, pupal case. 3, Chitin (Matheson, Coleman, and Bell, Practical Grade), through 325 mesh screen, in a KBr disc (15 milligrams chitin/gram KBr; 0.2 gram disc, about ½ inch diameter). 4, *P. rapae*, wing. 5, *Catocala cara* Gn, wing. 6, Bumblebee (*Bombus*), wing.

medium of refractive index about 1.54, which is the value reported for silk (Whewell, 1941).

Pupal Case: The case is on the order of 2.5 μ (0.1 mil) in thickness and 0.9 milligrams in weight (average of 4).

Wing: Like insect cuticle in general (Richards, 1953), the descaled wing membrane showed no strong birefringence, and gradually turned brown, but did not melt or flow, on heating in air to 360° C.

Infrared spectra (See Figure 3)

Silk: Rather good spectra were obtained on the silken mats wetted with chloroform, carbon tetrachloride, or Nujol and pressed between salt (NaCl) plates. The three bands of major interest (marked with arrows in Figure 1) are attributed to the N–H portion of the amide linkage (about 3.0 microns) and the carbonyl group (Amide I band at 6.0–6.1 microns). Also, the typical Amide II band (of uncertain origin) appears at 6.5–6.6 microns. (For a general discussion of polyamide spectra see Bellamy, 1958.) The other strong bands are due to the Nujol.

It is interesting that the fibers of the *Pieris rapae* mat were sufficiently fine (about 3 microns) to give a good spectrum, while commercial silk, whose monofilaments are about 11 microns in diameter, would not give acceptable results by the same technique.

Pupal Case: The N–H, Amide I, and Amide II bands appear in the spectra of the pupal case and of chitin. In addition, the –OH band, not shown strongly by the silk, which has relatively little hydroxyl (due to water and serine), appears at about 2.9 microns. In the case of chitin the –OH band is stronger than the N–H band, which seems to appear as a shoulder, while the pupal case shows a stronger N–H band than –OH band. This situation is consistent with the presence of considerable protein as well as chitin in the pupal case.

Wing: In the insect wing spectra of Figure 3 the –OH band at about 2.9 microns appears as a shoulder, and the N–H band at about 3.0 microns is relatively more intense than in the spectrum of the pupal case. This suggests that there is less chitin in the wing membrane than the pupal case (see nitrogen analyses below).

Infrared spectra often are used as distinctive "fingerprints" (7–15 micron region) for pure compounds, and in the present case they show the essential chemical identity of the wing membranes of a butterfly, a moth, and a bumblebee. Incidentally, *Speyeria* and *Papilio* wings gave spectra nearly identical to that of *Pieris rapae*.

Elemental analyses (Table I) and chitin content

Silk: The nitrogen content of the silken mats is comparable to that

TABLE I

ELEMENTAL ANALYSES (BY GALBRAITH LABORATORIES, KNOXVILLE, TENN.) AND CALCULATED CHITIN CONTENTS

Material	Carbon (%)	Hydrogen (%)	Nitrogen (%)	Calculated Chitin (%)[1]
Silken mats (*Pieris rapae*)	42.87	6.40	13.88	0
Pupal cases (*Pieris rapae*)	48.63	7.46	8.72	71
	–	–	9.07[2]	67[2]
Descaled wing (*Pieris rapae*)[3]	–	–	12.75	17
Chitin ($C_8H_{13}O_5N$), calculated	47.29	6.45	6.90	–
Chitin, practical (Haynes, 1960)	–	–	6.0–6.6	–
Sericin (*Bombyx mori*) (Whewell, 1941)	42.60	5.80	16.50	0
Fibroin (*Bombyx mori*) (Whewell, 1941)	48.53	6.43	18.33	0

[1] Calculated from % nitrogen assuming two-component system of protein at 14% N and chitin at 6.6% N.
[2] Dried at 80–85° C. and less than 1 inch Hg pressure for seven hours; 7% weight loss.
[3] The wings had been allowed to dry in the air (40–60% rel. humidity) for several weeks. Water content was estimated by drying wings (8.3 milligrams) at 100° C. and less than 1 inch Hg pressure for 10 hours; the weight loss was 0%.

recorded for *Bombyx mori* sericin and fibroin though somewhat lower, probably at least partly because of the presence of moisture (said to comprise 11% of raw silk, as mentioned above).

Pieris rapae silk (mats) was dissolved in less than five minutes by 10% aqueous potassium hydroxide at 95–100° C. or in the course of one hour by 2% sodium carbonate at the same temperature. This solubility is consistent with the absence of chitin.

Pupal Case: Two nitrogen determinations were made, one on a dried sample. Assuming a two-component system (protein plus chitin) with a modest value (14%) for protein nitrogen (so as not to exaggerate chitin content) and a value (6.6%) slightly lower than theory for chitin (because reported N values for chitin are always too low, as mentioned by Richards, 1953), chitin contents of 71% (undried sample) or 67% (dried sample) were calculated. Values of 47% chitin (as % of dry cuticle) have been reported for the *Sarcophaga* puparium (Richards, 1953). The chitin is supposed to be combined with protein in the form of a complex of the materials.

As another approach to determining chitin content, pupal cases (3.5 milligrams) were heated with 2% sodium carbonate solution at 95–101° C. for three hours, recovered, and dried at 85–90° C. and less than one inch Hg pressure for one hour; the final weight was 2.3 milligrams (34% loss), and correcting this for the weight loss (6%) on drying an untreated sample under the same conditions gives 28% weight loss, presumably protein, which should be removed by this procedure (Haynes, 1960).

Similar treatment with 10% potassium hydroxide gave a corrected weight loss of 27%; treatment with 5% KOH is said to remove protein (Rudall, 1954). The same KOH treatment of practical-grade chitin resulted in a loss of 12%, and both the KOH-treated pupal cases and chitin gave a positive chitosan test (by grinding 2–10 milligrams material in a glass mortar with two drops of a solution prepared by addition of 1.2 grams iodine and 1.6 grams potassium iodide dissolved in 1.5 ml. water to 50 grams of 20% aqueous acetic acid and then by adding seven drops of 50% sulfuric acid to give a violet slurry if chitosan is present, or an orange-brown slurry in the case of untreated chitin).

Pupal cases, like chitin, were not completely dissolved by heating in 50% sodium hydroxide at 130–136° C. for four hours, and the residual matter gave a positive chitosan test. The pupal cases that had been treated with 2% sodium carbonate gave a doubtful or weak chitosan test (brownish-purple color).

In conclusion, both the nitrogen analysis and the alkaline treatments suggest a chitin content of very approximately 70% for the pupal case.

Wing: A value of 17% chitin was calculated from the nitrogen analysis (Table I). The presence of chitin was shown qualitatively by the fact that descaled wings were incompletely dissolved by 50% NaOH at 130–135° C. for four hours; the residual matter gave a positive chitosan test. A wing was dissolved almost completely by concentrated hydrochloric acid (38% HCl) after five hours at room temperature. Chitin can be dissolved by this acid (Whistler, 1953).

Note that the infrared spectra, as discussed above, are consistent with a considerably higher chitin content for the pupal case than for the wing.

Amino acids

Silk: Silken mats (6.9 milligrams) were hydrolyzed by heating with 0.48 ml. concentrated hydrochloric acid (38% HCl) at 95–99° C. for 1.5 hours. The resulting brown solution was boiled down to about 0.05 ml. and spotted approximately ⅝ inch from the shorter edge of a 3 × 4.5 inch sheet of Whatman No. 1 filter paper, which then was dipped (spotted edge down) to a depth of about ¼ inch in a layer of solvent within a closed container according to the ascending method of paper chromatography (See, for example, Lederer and Lederer, 1953). After 45–60 minutes, the chromatogram was dried in an oven at 109° C. for two to four minutes, dipped in 0.25% ninhydrin in acetone, and dried for another two minutes in the oven to develop the spots, which were encircled (and colors noted) immediately, before they began to fade. Known solutions of the amino acids in concentrated hydrochloric acid were used for comparison.

s-Collidine (saturated with water) as solvent gave excellent results; glycine (rust red; R_f 0.07), alanine (purple; R_f 0.13), and tyrosine (gray-green; R_f 0.36) were identifed in the *Pieris rapae* silk hydrolyzate and in a similar hydrolyzate of commercial silk thread by means of both the R_f values (ratio of distance traveled by spot to distance traveled by solvent front) and the distinctive colors. It is understood, of course, that identification in this manner is never positive, but in the present case there seems little reason for doubt. Serine was identified (rose-brown; R_f 0.21) in the case of both the mats and the commercial silk using phenol (saturated with water) as the solvent, while leucine (violet; R_f 0.67; pink spot appeared on ageing) was found using n-butanol (saturated with water) in the case of the mats but not the silk thread. This is explained by the fact that sericin, which is washed from raw silk, contains principally glycine, alanine, tyrosine, and leucine, while fibroin contains mainly glycine, alanine, tyrosine, and serine (Hayes, 1954).

Judging by the relative size of the spot, the proportion of leucine was much reduced in the hydrolyzate of the fibers recovered (Figure 2) when mats were boiled with soap and ammonia solution as described above. This is consistent with the anticipated concentration of leucine in the "gum" visible in Figure 1.

Pupal Case: Pupal cases were hydrolyzed and chromatographed as above. Glycine, alanine, and tyrosine were tentatively identified, while the serine spot seemed relatively weak.

Wing: Hydrolyzed wings gave the same result as the pupal cases. Thus, both chitin and protein were qualitatively identified in pupal cases and wings, and the nitrogen analyses (and alkaline treatment of the cases) give some idea of the chitin/protein ratio according to the simple two-component conception.

SUMMARY

Some observations were made on the physical and chemical properties of cuticular materials of *Pieris rapae*.

The filaments in the silken pupal girth are comparable to commercial silk (fibroin) in ultimate tensile strength, while the silken mat beneath the pupa consists of filaments heavily laden with a viscous liquid, presumably sericin, which is removed by boiling with an ammoniacal soap solution. Elemental analysis, infrared spectrum, and the presence of glycine, alanine, tyrosine, serine, and leucine in the acid hydrolyzate suggest that the mat is generally similar to raw *Bombyx mori* silk.

The presence of chitin in the pupal case left behind on eclosion was shown qualitatively by the infrared spectrum and the chitosan test, while glycine, alanine, and tyrosine were tentatively identified by paper

chromatography on the acid hydrolyzate. A chitin content of very approximately 70% was calculated from the elemental nitrogen analysis and was supported by the results of alkaline extractions supposed to remove protein.

The presence of the same amino acids was indicated for the descaled wing as for the pupal case, and again chitin was shown to be present by the infrared spectrum and by the chitosan test. However, the spectra indicated a lower level of chitin in the wing than in the pupal case, and, in accord with this, nitrogen analysis indicated very approximately 17% chitin in the wing. The infrared spectra of the wing membranes of *Pieris rapae* (and other butterflies), a moth (*Catocala*), and a bumblebee (*Bombus*) were nearly identical.

Acknowledgment

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NEW HESPERIIDAE RECORDS FOR MEXICO

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With the publication of the "Catalogo sistematico y zoogeografico de los lepidopteros Mexicanos. Segunde parte-Hesperioidea," by C. C. Hoffmann (1941), the first organized effort to assemble data on the Hesperiidae of Mexico was made, Hoffmann recorded 456 species that were reputed to occur in that country. Godman and Salvin (1887–1901) in "Biologia Centrali-Americana, Insecta, Lepidoptera-Rhopalocera, II," described a large number of new species and genera from Central America, including Mexico. In some cases their records were incomplete and they made no effort to tabulate a complete list of species for that country as that was not their primary purpose. W. H. Evans (1951–1955) prepared one of the most important publications on the Hesperiidae to date, "A catalogue of the American Hesperiidae indicating the classification and nomenclature adopted in the British Museum." Parts I–IV. He recorded all of the known Mexican records based on specimens in the British Museum, and in some cases on other available data. E. L. Bell (1942) published "New Records and New Species of Hesperiidae from Mexico." H. A. Freeman (1951) published "New Skipper records for Mexico," and C. D. MacNeill (1962) published "Preliminary report on the Hesperiidae of Baja California."

I have been working with the Hesperioidea of Mexico since 1935 and in recent months I started organizing the published data on that subject with the purpose in mind of making a detailed study of the Hesperiidae of Mexico. If a species is found in Mexico that is not listed in any of the above-mentioned publications, it can be considered to be a new record for that country.

While Don Stallings and I were visiting with Dr. Tarsicio Escalante, Mexico, D. F., during August, 1964, he suggested that I work over his Mexican Hesperiidae numbering several thousand specimens. Later that year he sent the first shipment, and thus far a number of very interesting species have been mounted and determined from that group. All of the Mexican Hesperiidae collected by Stallings and Turner have been turned over to me for study and two new records for Mexico have been found in their material.

The following are nine of the new records thus far determined from the specimens that I have available for study.

[1] I am deeply thankful to the National Science Foundation for research grant GB-4122 which is making this study of the Hesperiidae of Mexico possible.

Elbella dulcinea (Ploetz), 1879, new status

Evans regarded *dulcinea* as a subspecies of *scylla* (Ménétriés), 1855, however they occur together in the same areas of Veracruz. They differ somewhat genitalically and morphologically, thus indicating that they actually are specifically different. I have one male, collected at Sierra Blanca, Veracruz, August, 1943, and one male from Presidio, Veracruz, June, 1943, in my collection that appear to be the first records for this species from Mexico. Previous records are Costa Rica, Panama, Colombia, Venezuela, and French Guiana.

Elbella patrobas (Hewitson), 1857

Among the specimens received from Dr. Escalante, was a male *patrobas*, collected at Catemaco, Veracruz, January, 1953, and a female from Chimalapa, Oaxaca, August, 1952. These appear to be the first recorded specimens of this species from Mexico. Evans records Guatemala, Honduras, Nicaragua, Panama, and Colombia (Valdivia, Rio Chili) as representing the general distribution of this species based on specimens contained in the British Museum.

Urbanus esma Evans, 1952

Contained in the Escalante specimens was a male *esma*, collected at Catemaco, Veracruz, during September, 1964. This is the first record of this species from Mexico. Evans records *esma* from Panama, Colombia (Rio Negro, Choco, Rio Condote), and British Guiana (Iquitos, Obidos, Rio Tapajos).

Astraptes colossus (Herrich-Schäffer), 1869

There are two specimens of this species in the Escalante material, one a male collected at Paraje Nuevo, Veracruz, April, 1952, and the other a female from Chimalapa, Oaxaca, August, 1952. These two specimens appear to represent the first recorded occurrence of this species in Mexico. Previous records are Guatemala, Honduras, Colombia, and Venezuela.

Damas clavus (Herrich-Schäffer), 1869

There is a male of this species in the Escalante material collected at Catemaco, Veracruz, March, 1961. This is the first record of this species for Mexico. Previously it had been recorded from Guatemala well into tropical South America.

Panoquina evansi (Freeman), 1946

Whether *evansi* is a separate species or a subspecies of *fusina* (Hewitson) 1868 as listed by Evans is a problem for later study. For the present

I will consider it as a species as originally described. In the Escalante specimens there was a male *evansi* from Acahuizotla, Guerrero, July, 1960, and a female from Catemaco, Veracruz, January, 1953. It was previously recorded from Pharr, Texas by the author of the species and by Evans from Guatemala and Trinidad.

Aides aegita (Hewitson), 1866

In the Escalante material there was a male *aegita* collected at Catemaco, Veracruz, January, 1953. This is the first record of this species from Mexico. This species has been previously recorded from Panama, and several areas in north central South America.

Xeniades orchamus (Cramer), 1777

In the specimens received from Stallings and Turner, there was a male specimen of *orchamus* that they had collected at Mante, Tamaulipas, June 9, 1941. There are no previous records of this species from Mexico. Evans records it from Panama well into South America.

Saliana antoninus (Latreille), 1824

Stallings and Turner collected one male and two females of this species at Valles, San Luis Potosí, December 30, 1941. I can find no recorded evidence of this species having previously been collected in Mexico. Evans stated that in the British Museum there were specimens from Guatemala, Honduras, Nicaragua, Costa Rica, Panama, and several locations in South America.

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LARVAL FOOD PLANTS AND DISTRIBUTION NOTES FOR THREE TEXAS HESPERIIDAE

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Larval food plants are here recorded for the first time for Texas populations of *Poanes viator* (Edwards), *Ancyloxypha numitor* (Fabricius), and *Erynnis brizo burgessi* (Skinner). Also, a few notes on broods and spatial distribution are given. The arrangement and nomenclature follow dos Passos (1964).

Poanes viator (Edwards)

Edwards described this species in 1865, and apparently nothing has heretofore been published on its life history. The distribution of *viator* in Texas is based on a few scattered records and is therefore not well defined. However, through careful collecting this insect should be found closely associated with its larval food plant, marsh millet, *Zizaniopsis miliacea* (Michx.) Doell. & Archers (Gramineae) which occurs over most of the eastern half of Texas. Present knowledge indicates that this skipper is multiple-brooded; it has perhaps four generations in Texas. A larval or pupal diapause is indicated, but additional research will be necessary to determine this.

Guadalupe County: On 19 June 1965 at Lake Dunlap near the village of Clear Spring, adults were found in abundance flying in and around the tall marsh millet which covers several acres in the shallow backwaters of the lake. After collecting 49 males and six females, a cursory examination was made of several *A. miliacea* plants for immatures. Since we were not equipped for marsh collecting, only plants which could be reached from the bank were examined. One empty pupal case, one live pupa, one dead last-instar larva, and three live larvae were collected. Two of the larvae were preserved. On 27 June a male emerged from the pupa. The one larva which was reared through pupated 24 June and a male emerged 2 July.

Larval habits of this species are quite interesting. A formal shelter, which is characteristic of so many skippers, is not constructed. The larva of *viator* hides deep in the recess between the sheath and stem of the food plant when not feeding. The hiding place is above water level. Feeding is mostly on the upper half of the grass blades. Pupation occurs in the unimproved shelter. A bit of silk is placed in the bottom of the recess and along the sides, and the larva then pupates head-upward with the cremaster loosely anchored at the bottom.

On a return visit to the spot on July 25 even more adults were on the wing. Forty-two adults, all males, were collected two and three at a time, mostly on the blossoms of *Ampelopsis arborea* (L.) (Vitaceae), at about midday. It was theorized that females had not yet emerged or were

ovipositing on the *Z. miliacea*, and hence, were not visiting flowers at the time.

The writer and Mrs. Kendall have collected or observed *viator* in three other Texas counties: Bexar Co., near San Antonio, one seen at close range, 16 May 1964. Comal Co., New Braunfels, 9 May 1954 (1♀). Nueces Co., Calallen, 11 April 1962 (1 ♂). Freeman (1951) indicated that *viator* has been collected at Waco, McLennan County, in July and August, and at Dallas, Dallas County, on 17 July 1948.

Ancyloxypha numitor (Fabricius)

The "least skipper" is distributed over a wide area in east, central, and southern Texas. It flies from April to November and may be found at or near watercourses and wet places where its larval food plants grow. There appear to be at least four broods in central Texas. The only known larval food plant in this area is marsh millet, *Zizaniopsis miliacea* (Michx.) Doell. & Archers (Gramineae). Since the insect has been collected in places where this plant was not found, it may be assumed that other local grasses, associated with wet places, are equally acceptable as larval food plants. A diapause is indicated but the specific immature stage in which it takes place is unknown.

Karnes County: On 25 July 1965 at a small stream near the village of Gillett, fresh adults were observed fluttering about *Z. miliacea* which was growing in the water. In addition to six freshly emerged males, 17 larvae, three pupae, and six empty pupal cases were collected on *Z. miliacea*. Several larvae and pupae were preserved. Adults emerged from five of these pupae as follows: 27 July (2♂♂), 29 July (1♂, 1♀), 31 July (1♂). Larvae which were reared through pupated: 26 July (1), 3 Aug. (2), 5 Aug. (1), and 13 Aug. (1); adults emerged: 1 Aug. (1♀), 10 Aug. (1♂), and 16 Aug. (1♀).

The larva lives in a leaf shelter constructed by cutting and folding over a small portion of the long grass blade. Early instars select the terminal edge while older larvae move toward the median section of the leaf blade. Pupation takes place in the leaf shelter, on the living plant suspended above its aquatic environment.

Other Texas counties in which the writer and Mrs. Kendall have observed or collected *numitor* are: Bastrop Co., Bastrop State Park, 5 Sept. 1961 (4♂♂); 25 Aug. 1962 (2♂♂, 1♀); 7 Aug. 1965 (8♂♂). Bexar Co., San Antonio, 1 Aug. 1964 (13♂♂, 1♀); 25 Oct. 1964 (3♂♂). Comal Co., near New Braunfels, 27 July 1963 (1♀); 7 Nov. 1964 (1♀); 11 April 1965 (1♀); 19 June 1965 (1♂). Guadalupe Co., Clear Spring, 19 June 1965 (1♂). Kerr Co., 8 mi SW of Hunt, 27 June 1963 (3♂♂, 1♀); Dr. John M. Burns, who accompanied the writer, collected 10 adults the same day. Kimble Co., near Junction, 20 July 1963 (1♂). Smith Co., near Tyler, 31 Aug. 1963 (3♂♂, 2♀♀).

Freeman (1951) recorded *numitor* from six Texas counties: Bowie (Texarkana), August; Comal (New Braunfels), April to November; Dallas (Dallas), June to October, (Garland), July and August, (Lancaster), June to October; Hays (San Marcoe), April to November; Hidalgo (Pharr), October.

Erynnis brizo burgessi (Skinner)

In his excellent treatment of *Erynnis*, Burns (1964) indicated that this species was strictly univoltine. Recent rearing studies, conducted in an outdoor environment, indicate *burgessi* to be multiple brooded, although oviposition and egg development took place under laboratory conditions. Additional research is necessary to determine which stage and what conditions are involved in the initiation of diapause. Oak is confirmed as the larval food plant. Nothing can be added to its known spatial distribution.

Brewster County: On 1 April 1965 in Green Gulch at Big Bend National Park adults were found flying in fair numbers. These were mostly males which were patrolling certain areas, stopping only briefly on blossoms of wild flowers. Several species of oak may be found in Green Gulch. We were operating with a research permit, and two males were collected. On the following day, five males and one female were taken, and the female was kept alive for eggs. The elusiveness of *burgessi* was clearly demonstrated by one which escaped from the beak of a roadrunner, *Geococcyx californianus* Lesson. As the writer was attempting to capture a specimen, the roadrunner suddenly appeared, quickly approached, and plucked the quarry from the flower on which it was feeding. The skipper was not to be captured as it freed itself with a violent flapping of wings and disappeared.

Under laboratory conditions, 31 eggs were deposited between 5 and 10 April, mostly on the stems of terminal twigs of *Quercus fusiformis* (Small) (Fagaceae). The eggs started hatching on 10 April. Seven eggs and other immature stages were preserved. Larvae were placed outdoors on a caged, living plant 28 April. Since I assumed that the larvae would soon enter diapause, only infrequent examinations were made thereafter. On 12 June it was discovered that two larvae had pupated and one of these had already emerged; the adult could not be found. The remaining larvae pupated: 19 June (1), 20 June (3), 22 June (1), 23 June (1), 25 June (1), 27 June (1), 29 June (2), 30 June (1), 6 July (1), and 9 July (1). Pupation occurred in leaf shelters on the living plant. The manner in which this species pulls two leaves together to form the shelter provides excellent camouflage and renders the shelters almost undetectable. Seven males and five females emerged: 19 June (1♂), 24 June (1♂), 25 June (1♂), 26 June (1♂), 29 June (1♀), 30 June (1♂), 2 July (1♂), 5 July (1♀), 9 July (1♂, 1♀), 10 July (1♀), and 16 July (1♀).

No adults were found on a return visit to the Green Gulch site 30 April 1965, but on 8 and 9 September, several *Erynnis* which were thought to be *burgessi* were seen. The identity of one was confirmed when it chanced to light on the fruit of a prickly pear, *Opuntia engelmannii* Parry, close to the writer. These data might lend credulity to

the collection data accompanying a specimen examined by Burns (1964) from Paradise, Arizona, which was reputedly collected in July.

Burgessi has been collected in four additional Texas counties from late March to early May by various collectors as recorded by Burns (1964): Armstrong, Blanco or Burnet, Culberson, and Jeff Davis.

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MELANIC MOTHS OF THE GENUS *OPOSTEGA* (TINEOIDEA)

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In connection with examining specimens of *Opostega* from a number of North American museums and several private collections for the purpose of publishing a pictorial key (Eyer, 1964), I noted the presence of melanic individuals of *O. cretea* Meyrick, and *O. quadristrigella* Chambers. Information concerning melanic individuals of North American Opostegidae is, to the author's knowledge, absent in the literature. With the hope that collectors of microlepidoptera will watch for additional examples of such aberrations, especially in light trap collections, photographs and comments concerning their general color and characteristic markings are presented.

In a recent article on melanic tendencies of noctuid and geometrid moths in Pennsylvania, Sharpiro (1964) comments, "Industrial melanism has become standard citation in the literature of genetics and evolution, but relatively little has appeared in the United States on the subject . . . ." Since the melanic specimens of *O. cretea* described here were collected in both industrial and nonindustrial areas and those of *O. quadristrigella* only in nonindustrial areas, further collection and observation is especially desirable.

[1] Journal Article No. 242. Agricultural Experiment Station, New Mexico State University, University Park, New Mexico.

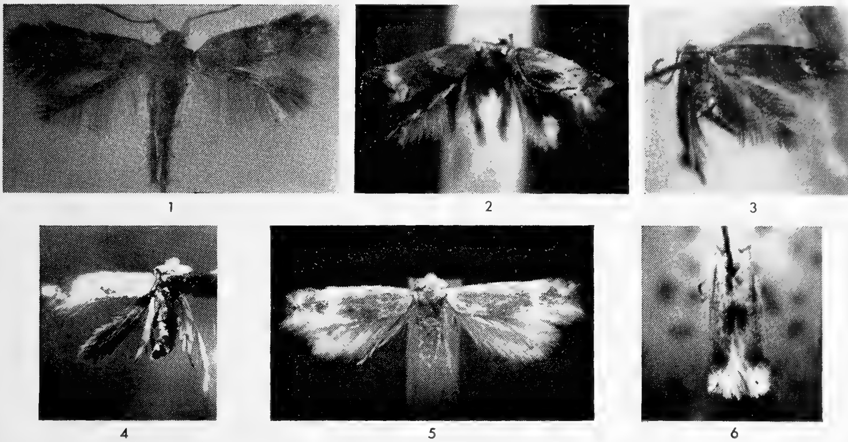

Fig. 1, *Opostega cretea* Meyr., ♀, Ottawa, Canada, 17 July 1905; Fig. 2, *O. cretea* Meyr., ♀, Fishers, N. Y., 21 July 1933; Fig. 3, *O. cretea* Meyr., ♂, Rochester, N. Y. 30 July 1933; Fig. 4, *O. cretea* Meyr., ♀, Lake St. Francis, Newago, Quebec, no date; Fig. 5, *O. quadristrigella* Cham., ♀?, Balsam, N. C., 19 July 1911; Fig. 6, *O. quadristrigella* Cham., ♀, same locality.

Opostega cretea Meyrick

Example 1. Figure 1; Female, Ottawa, Canada, July 17, 1905 (C. H. Young). This was the first melanic specimen observed by the author. It was in a series of seven specimens borrowed from the Canadian National Museum in 1933. Although it was the only melanic in the series, the genitalia were not removed. As can be seen from the figure, the specimen was badly rubbed and little could be determined about the color of the vestiture of the head and eye caps. The remainder of the specimen was a uniform light chestnut brown. The posterior and apical fringes were in poor condition and the strigils, apical spot, and dorsal spot were not discernible. The entire exoskeleton was darker than that of accompanying specimens with normal white coloration.

Example 2. (Not figured); In a later collection of the C.N.C. borrowed in 1951, another female specimen collected by C. H. Young on June 25, 1932 from the same locality was observed.

Example 3. Figure 2; Female, Fishers, New York, July 21, 1933 (A. B. Klots). This specimen, which was in excellent condition, although not well spread, had forewings dark chestnut brown overlaid with purple to brown scales, especially in the regions of the strigils and dorsal spot; it also had a well-defined apical spot. The patagia were purple–brown. The hindwings were of the same color, but with fewer purple–brown scales. The vestiture of the head and eye caps was yellow–brown and

the flagellum of the antenna darker brown. The thorax and legs were dark brown; the abdomen the same, but more creamy on the lateral surfaces. This specimen is in the collection of the American Museum of Natural History.

Example 4. Figure 3; Male, Rochester, New York, July 30, 1933 (A. B. Klots). This specimen is quite similar to Example 3, but is sufficiently lighter in color to reveal the apical fasciae clearly. The cluster of scales and hairs immediately preceding these are maltese grey, a color which is characteristic of most of the forewing surface on Example 5, described below. The brown hairs of the apical and dorsal fringes of the forewing are also intermixed with the same grey. The patagia are straw-white and the frontal hair tuft and eye caps are silvery white with a touch of straw. This specimen is also in the collection of the A.M.N.H.

Example 5. Figure 4; Female, Lake St. Francis, Newago, Quebec (no date) (H. S. Parish). In this specimen, maltese grey prevails in the ground color of the forewings, greyish brown in the hind wings. The dorsal spot and fasciae are more clearly visible than in either examples 1 or 3. This specimen is in the collection of Cornell University.

OPOSTEGA QUADRISTRIGELLA Chambers

Example 1. Figure 5; Female?, Balsam, North Carolina, July 19, 1911 (Annette F. Braun). In this species the melanic coloration of the scales, fringes, and hairs is not shared by the exoskeleton to the same extent as in *O. cretea*. The overall hue is either grey or yellowish grey and the grey scales and hairs obscure the dorsal spot and four apical strigils almost completely. Several other specimens showing this type of melanism (Fig. 6) and from the same locality are in the private collection of Miss Braun and also in the U. S. National Museum.

Example 2. Female, Black Mountains, North Carolina, "28–VI" (Wm. Beutenmüller). This specimen, which is also deposited in the A.M.N.H., is more yellowish brown than the ones from Balsam, but the general melanistic pattern is similar and a photograph seems unnecessary.

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CAUSES OF DEATH ENCOUNTERED DURING REARING OF *DANAUS PLEXIPPUS* (DANAIDAE)

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In the process of rearing over 1600 *Danaus plexippus* (L.) during the summers of 1964 and 1965, we had an excellent opportunity to observe symptoms which repeatedly led to death during the course of metamorphosis of this insect. Rearing was done in Newton, Massachusetts by Mrs. Brewer, using the biology laboratory and research facilities of Newton Junior College. Diagnoses of abnormal conditions were made by Mr. Thomas at the University of California, Berkeley.

With the exception of a few eggs set aside for experimental purposes which have been previously described (Brewer, 1966), the insects were reared for purposes of tagging and release in migration studies, and every attempt was made to bring as many of them as possible to maturity. All insects reared in 1965 originated from field collected small larvae or from eggs deposited by newly collected adults, as we were unable to carry any individuals of the 1964 strain through the winter.

Only about a third of the original eggs survived to maturity in each year. The greatest loss, and the most difficult to relate to any specific cause, occurred up to and during the third instar. No cannibalism was observed at this stage, beyond damage wrought by newly hatched larvae which sometimes chewed into nearby eggs. This is understandable, since in nature usually only one egg is laid on a leaf by any one female, while in captivity there were up to fifteen on a leaf.

Some larvae were undoubtedly lost during the transfer to fresh food, some drowned, and some just simply disappeared. After the onset of the third instar, however, the symptoms accompanying death became relatively easy to recognize.

Parasitism was held to a minimum. Three or four larvae were parasitized by the tachinid fly *Lespesia archippivora* (Riley). In these cases the larvae suspended, but died prior to pupation. A white maggot issued from each larva, lowered itself to the floor of the rearing cage by a silken thread, and there formed a brown puparium. This was the only parasite we noticed.

Other tachinids and hymenoptera are known to feed upon *Danaus* (e.g., see Thompson, 1945 and Scudder, 1889).

A search of the literature shed light on only one of the conditions with which our animals were plagued—one which we labelled "black death." Symptoms of this condition became evident in these larvae just before

pupation. The larvae migrated to a horizontal surface in the usual manner. A few hours later they died clinging to the surface by one pair of prolegs while both head and abdomen hung limp on either side, and shortly thereafter turned black. Nine larvae in this condition were found in the field in 1963. Seven developed symptoms during rearing in 1964. The symptoms agree with a description by Brown (1927) of larvae of *D. plexippus* which he found had been infected with *Micrococcus flaccidifex danai* (Brown). In 1965 only one of our larvae exhibited these symptoms. Examination of it did not disclose the above microbe, nor did it disclose any polyhedral virus such as that defined by K. M. Smith (1950), which causes similar behavior and symptoms in many insects.

The following conditions were also present during both the first and second year (1964 and 1965).

Rusting.—This condition was so-called because after death the larvae became a rusty orange-brown color. Most were affected in the third instar. The larvae grew at a slow rate and behaved in a generally sluggish manner. Usually they had noticably deep yellow bands and often the thoracic filaments were either longer or shorter than usual. Some individuals showed another symptom which we called "black mask," because the head capsule, instead of being shed, remained glued to the face after moulting. The appearance of the animal in the initial stages of this condition was much the same as that of a normal larva about to moult. The whole area anterior to the thoracic filaments was swollen and misshapen, being at least three times its normal size. Some started to moult and some moulted completely, but in all cases the head capsule turned a glistening black and the larva was unable to cast it off. It soon became a tight button-like protuberance covering and constricting the eyes and mouthparts, while the posterior part of the head remained a bulge. These larvae became moribund, apparently could not eat, and soon died. Not all these larvae became rusty, and not all the rusty larvae bore "masks."

Blurred scaling.—Malformed adults with this condition could immediately be recognized by defective wing scaling. The black scaling of the veins was excessive and had an uneven, blurred, sometimes splotchy appearance. The veins themselves were often crooked. In most cases other abnormalities were also present including unpigmented antennae, malformed palpi, scarred abdomen and nonfunctional proboscis. In most individuals the apices of the forewings were either greatly shortened or greatly produced, and in some the wings were further deformed. The majority of these insects, but not all, emerged from irregular chrysalids which were roughened on the surface, uneven in shape, or whitish in

hue. Most of these adults expired within a few days, and the remainder appeared totally unequipped to survive under natural conditions. In several years of insect tagging we have never encountered any monarchs possessing these symptoms in the field.

Animals suffering from any of the four above described syndromes were found to be infected with *Pseudomonas aeroginosa* (Migula), a bacterium considered a potential insect pathogen in that it has no invasive powers of its own, but will enter the hemocoel and cause a fatal septicemia when an insect has been weakened by some other cause. It is a pathogen which commonly is responsible for secondary infections among insects reared in the laboratory, due to artificial physical conditions, wounding, or cannibalism which results from crowding.

A fifth condition, which was present in both 1964 and 1965, affected certain chrysalids in which the wing and abdominal sections were separated by deep clefts. In some of these it was possible to see the blood circulating beneath a thin membrane. Some of these pupae lived for as long as a week, but none reached the point of adult emergence. Dissection and examination by phase microscopy disclosed no apparent microbial etiology. There was no infection by nematodes, protozoa, fungi, bacteria or viruses. Cultures set in AC Medium[1] produced no microbial growth at all. It seems possible, therefore, that environmental factors may have been the cause of this condition. Malnutrition, insecticides, jolting of the cages at a crucial time, overcrowding, and lack of normal light, heat and humidity are all factors to be contended with in the rearing of insects, and none of these can be entirely eliminated in the cases under discussion except insecticides, against which the animals were zealously guarded.

Genetic factors may also have been involved. Most of the insects reared in 1964 were the second generation, and in 1965 the third generation, the original insects in both years having been found in the field as either eggs or very small larvae. The parent insects were probably, for each group, the offspring of a single female, so that in each case we had an inbred population which arose not by design, but owing to the scarcity of eggs. This may have had a debilitating effect, as indicated in Table I.

The animals collected in 1963 originated from breeding grounds in three states and were collected between July 19 and August 30 in all stages of development from egg to fifth instar. There were not more than 16 to a cage at one time, as opposed to 40 or more to a cage in the other two years.

[1] AC Medium: A Difco product, recommended for the cultivation of both aerobic and anaerobic microorganisms, and used for preliminary cultivation of microorganisms associated with insects.

TABLE I. RELATIVE REARING SUCCESS IN FIELD COLLECTED AND LABORATORY BRED GENERATIONS OF *Danaus plexippus*.

Date	Number	Emerged	Percent
1963 Collected in field	187 (eggs & larvae)	179	95.7
1964 (New stock) second generation inbred	567 (eggs laid by one female)	206	36.6
1965 (New stock) third generation inbred	599 (eggs laid by one female)	189	30.3

If environment and genetics were the primary causes of the high mortality and *Pseudomonas aeroginosa* a secondary cause, it would appear that we have not uncovered any disease of sufficient proportions to be responsible for the great fluctuations in numbers of the monarch from year to year. We hope that these symptoms and their causal agencies will prove useful to other investigators.

ACKNOWLEDGMENTS

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THE AUTHORSHIP OF *POLITES MYSTIC*, EDWARDS OR SCUDDER? (HESPERIIDAE)

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Both W. H. Edwards and S. H. Scudder published the name *mystic* for the same skipper within months of each other. The problem has been, who published the name first? Edwards (1884: 312) noted "501. Mystic, Scud., Pr. Ess. Ins., 3, 172, 1862; Edw., Pr. E. Soc. Phil., 2, 15, pl. 1, 1863; . . ." Scudder (1889, 2: 1705) wrote "*Hesperia mystic* Edw., Scudd., Proc. Ess. Inst., iii:172–173 (1863); Proc. entom. soc. Philad., ii:15–16, pl. 1, figs. 3–4 (1863); . . ." It appears that each of these gentlemen bowed to the other in respect to the authorship of the name *mystic.*

Turning to secondary sources I find the following references to the authorship of the name: Kirby (1871: 599) assigns the name to Scudder; Strecker (1878: 165) names Edwards as the author; Skinner (1891: 16) makes Scudder the author. More recent standard checklists, by Barnes and McDunnough, Barnes and Benjamin, McDunnough and dos Passos all credit the name Scudder, apparently following Skinner. Lindsey, Bell and Williams (1931: 103) credit the name to Scudder. With this preponderance of apparent evidence it seemed the most redundant routine to check the actual publication date of Scudder's article.

Recently, while in Salem, Massachusetts, I had the opportunity to visit the Essex Institute and meet Mr. David R. Proper, the librarian. He very kindly allowed me to start a search of the primary documents in his keeping to establish the publication dates for both the Proceedings and the Bulletin of the Essex Institute. I soon found that mast-head dates and actual publication dates for these journals frequently differed by appreciable time. At the time that I had to leave Salem I had not reached any conclusion relative to volume 3 of the Proceedings in which Scudder's use of *mystic* first was published. Mr. Proper continued the search after I had left and found the evidence that is needed to bracket the publication of that volume into a period of three months.

The evidence is this: A printed notice of a Field Meeting at Salem on August 20, 1863, mentions as available volumes 1 and 2 of the Proceedings as published in parts at irregular intervals. No mention of any part of volume 3 is made. Volume 3 includes a report of a meeting held on December 28, 1863. The first part of volume 4 was released a day or so earlier than April 26, 1864 and was for the quarter January–March, 1864.

[1] This study was a by-product of N.S.F. grant GB-194 and GB-2741.

There is no evidence that volume 3 had been issued in parts. Thus it appears that volume 3 was issued after December 28, 1863, and before April 26, 1864. If, perchance, volume 3 was issued in parts, no part had been issued by August 20, 1863.

A study of the structure of volume 3 strongly supports the belief that it was issued all at one time and not in parts as had been the earlier and later volumes. Volume 3 commences with the minutes for the Annual Meeting held on May 9, 1860, and continues through those for the meeting of December 28, 1863. There are two references to publication of the Proceedings in the minutes of meetings recorded in volume 3. At the Annual Meeting held May 8, 1861, the Publications Committee reported releasing volume 2, part 2, in September 1860. The Publications Committee report presented on May 13, 1863, noticed release of the final (third) part of volume 2 during the preceding year. From dates of receipt of this part at other institutions I suspect that it was released in September or October, 1862.

Scudder's paper, "A List of the Butterflies of New England," was presented at the meeting of the Essex Institute held on March 10, 1862. It is printed in the extended minutes of that meeting. In this paper Scudder named seventeen species of butterflies from New England. All of these currently are quoted as having been published in 1862 or 1863. The correct date for each of these is between January 1, and April 26, 1864. It seems improbable that the volume was published within the last three days of 1863. Therefore I believe that the date used on the title page of volume 3, 1864, is the true year of publication.

The date of Edwards' use of the name *mystic* in print has been established (Brown, 1964: 213). If the preprint date is accepted, as has been informally approved by the Secretary of the International Commission on Zoological Nomenclature (Brown, 1964: 210), then the date to be used is April, 1863. If this date, in the future, is rejected, then the date to be used is July 29, 1863. Either of these dates has at least five months priority over the publication date for Scudder's use of *mystic*.

Scudder's use of the name in his article clearly acknowledges Edward's prior use of the name in manuscript. In fact, at the time that Scudder presented his paper, March 10, 1862, the name was in manuscript and not published. However, mere oral or manuscript presentation of a name does not have any standing in nomenclature. Thus *mystic* must be credited to W. H. Edwards.

The seventeen new names, the date of publication of which is changed from 1862 or 1863 to 1864, are listed below with notes concerning their current standing.

12.[1] *Polyommatus porsenna* is a subspeices of *Feniseca tarquinius* (Fabricius). dos Passos's date, 1863. No effect.
32. *Argynnis montinus* is a subspecies of *Boloria titania* (Esper). dos Passos's date, 1862. No effect.
35. *Melitaea oenone* is a synonym of *Melitaea nycteis nycteis* Doubleday. dos Passos's date, 1863. No effect.
36. *Melitaea harrisii.* dos Passos's date, 1862. No effect.
58. *Nisoniades persius* now is in *Erynnis.* dos Passos's date, 1863. No effect.
65. *Hesperia massasoit* now is in *Poanes.* dos Passos's date, 1863. No effect.
67. *Hesperia pocahontas* is a synonym (female form) of *Poanes hobomok* (Harris). dos Passos's date, 1863. No effect.
69. *Hesperia mystic,* now is placed in *Polites.* dos Passos's date, 1863. Change of authorship to W. H. Edwards from S. H. Scudder is required.
70. *Hesperia sassacus* Harris, in line 9 of the original description change "*H. incerta*" to "*H. mystic.*" (See Errata, p. [302] of the original publication.)
71. *Hesperia wingina* is a synonym of *Polites vibex vibex* (Geyer). dos Passos's date, 1863. No effect.
73. *Hesperia egeremet* was proposed as a new name for *otho* Boisduval and LeConte [1834] (*nec Papilio otho* Smith 1797). dos Passos's date, 1863. No effect.
74. *Hesperia manataaqua* was proposed as a new name for *cernes* Harris, 1862 (*nec cernes* Boisduval and LeConte, [1834]), and now considered a synonym of *Polites origines* (Fabricius). dos Passos's date, 1863. No effect.
76. *Hesperia oneko* is a synonym of *Amblyscirtes aesculapius* (Fabricius). dos Passos's date, 1863. No effect.
77. *Hesperia hegon* is listed as a synonym of *Amblyscirtes samoset* (Scudder). dos Passos's date, 1863. No effect.
78. *Hesperia samoset* now is placed in *Amblyscirtes.* dos Passos's date, 1863. The name *hegon,* which has line priority over *samoset,* was selected by Kirby (1871: 613) to be the name of this taxon. As first revisor he had the option of using either name, *hegon* which was applied by Scudder to the female or *samoset* which Scudder used for the male of the same taxon. This preceded Scudder's decision to assign the name *samoset* to the taxon in 1872 (p. 54) which was the basis for Evans's (1955: 389) reversal of custom followed by dos Passos. Edwards' name *nemoris* for the same taxon dates from April 1864 (Brown, 1964, p. 221) and thus is junior by a few months.
79. *Hesperia metea.* dos Passos's date, 1863. No effect.
80. *Hesperia monoco* is a synonym of *Lerema accius* (Smith). dos Passos's date, 1863. No effect.
81. *Hesperia panoquin* now is placed in *Panoquina.* dos Passos's date, 1863. No effect.

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[1] These are the numbers used by Scudder in his list.

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FLUID RECYCLING IN AGATHYMUS ARYXNA (MEGATHYMIDAE)

On 2 October 1965, while observing large numbers of *Agathymus aryxna* (Dyar) drinking at a stream in Ramsey Canyon in the Huachuca Mountains of southeastern Arizona, I observed an unusual behavioral phenomenon. On at least six occasions a male *A. aryxna* was observed to alight on a dry rock, curl its abdomen anteroventrally, and emit a drop of fluid from the anus. The megathymid then proceeded to siphon the fluid from the rock surface with its proboscis. On some occasions the drop of fluid was placed directly on the posteroventrally directed proboscis and on other occasions the drop was smeared on the rock face as the insect moved backward to bring the proboscis in contact with the fluid. The frequency with which this behavior was observed suggests that perhaps this is not an uncommon behavioral pattern for this species.

Feeding at water appears to be a well-documented behavioral characteristic for several species of *Agathymus*.[1,2] Roever reports "pumping" behavior of males but does not record recycling of the excreta. However, Roever (personal communication, 1965) reports that he has also observed the recycling behavior on occasion.

An analysis of the excreta might provide an explanation for the recycling behavior. Unfortunately, I did not obtain samples of the excreted fluid.

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[1] C. Brown & J. Creelman. 1935. Habits of *Megathymus stephensi* Skin. and notes on other *Megathymus* (Lepid.: Hesperiidae). Ent. News, 46: 175–177.
[2] K. Roever. 1964. Bionomics of *Agathymus* (Megathymidae). Jour. Res. Lepid., 3: 103–120.

NEW CANADIAN RECORDS FOR *THYMELICUS LINEOLA* (HESPERIIDAE)

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While vacationing along the north Lake Superior route via the Trans-Canada Highway during the summer of 1965, I unexpectedly collected specimens of *Thymelicus lineola* (Ochsenheimer) in the two widely separated locations in Ontario, Canada: Saulte Ste. Marie and Fort William. These records appear to represent a significant western range extension of the European skipper, subsequent to its collection at Sudbury, Ontario (Riotte, 1962), and a substantial northern extension from the site of the skipper's introduction at London, Ontario in 1916 (Klots, 1951). This species has also extended its range easterly, having been recorded from New Jersey (Muller, 1958), Connecticut (Apter & Burns, 1965), and New Brunswick (Hensel, 1966).

My first collection occurred in the city of Saulte Ste. Marie on July 26 at midday. A fresh male flew into my parked automobile on the north side of town. Other individuals were observed flying nearby. There were several large fields nearby which would offer an ideal habitat for this species; however, circumstances did not permit additional collecting in this location.

No further observations of this skipper were made along 440 miles of King's Highway 17 until arriving at Fort William, on the northwest shore of Lake Superior. On July 31, after an all-day rain, I spotted a fresh male *lineola* resting on a motel's brick front. At first, I assumed it may have just arrived there by way of one of many tourist automobiles from southern Ontario or Michigan, two areas where *lineola* abounds. The thought occurred to me that this skipper might have come from Saulte Ste. Marie, where it was observed in fair numbers just a few days before. However, shortly after our arrival in Fort William at 6:00 P.M., I took 20 additional specimens, all resting on wet grasses and miscellaneous weeds in a vacant lot. This sample area measured approximately 15 feet square and was typical of many fields and city lots in southern Michigan where the writer has collected *lineola* over a 20-year period. A total of 13 males and seven females in fresh condition were taken merely by using a small cyanide jar. Most of the skippers were clinging to grasses about 12 to 18 inches above the ground. When disturbed, they would fall to the ground without struggling to fly. Most of these specimens have now been deposited in the Royal Ontario Museum at Toronto.

It is interesting to speculate on how this population arrived and how long it has been established at Fort William; likewise, one may wonder whether or not the species will persist in this rather cold climate. Several of the new locations of *lineola* have been reported along main highways or railroads (Thomas, 1952). The Fort William collecting site is located between Highway 61 and tracks of the Canadian Pacific Railroad, both main arteries of tourism and commerce. Also, the site is a few city blocks from the largest grain terminal on the Great Lakes, which receives ships from all over the world, many passing through *lineola*-populated southeastern Michigan and Ontario. The railroad might offer the most likely route of introduction, in the form of eggs, larvae, or pupae, in hay shipped separately or used to feed livestock en route. Furthermore, empty boxcars or touring automobiles could offer a mode of transportation, for trapped adults from the population at Sault Ste. Marie, about two days' travel.

It appears that *A. lineola* could be making an appearance in other communities in the upper Great Lakes in the coming years. Collectors in northern Minnesota and Wisconsin, as elsewhere in Ontario, should be on the alert for this skipper, especially in those communities along principal routes of travel. No field or city lot is too small to harbor this species. Perhaps it is just a matter of time before this minute traveler reaches the Mississippi River and points farther west.

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BOOK NOTICE

BUTTERFLIES OF THE DELAWARE VALLEY, by Arthur M. Shapiro. 79 pp., illus. Special Publication of the American Entomological Society. 1966. Available from the Society, 1900 Race Street, Philadelphia. $1.50.

This work deals primarily with the 126 species of butterflies and skippers found within 35 miles of Philadelphia, in Pennsylvania and New Jersey, and emphasizes local distribution and habitats. Keys and drawings should permit identification of almost all species. A far more valuable publication than most local lists, and one which any entomologist in the area would find useful.—PETER F. BELLINGER, *San Fernando Valley State College, Northridge, California.*

PHYCIODES BATESII (NYMPHALIDAE) IN MISSISSIPPI: AN EXAMINATION OF THE PROBABILITY OF OCCURRENCE

Bryant Mather
Jackson, Mississippi

Before publication of "The Butterflies of Mississippi" (Mather and Mather, 1958), the possibility of the occurrence of *Phyciodes batesii* (Reakirt) in Mississippi was considered, and we concluded that it was so remote as not to merit mention. It was thus with considerable surprise that I learned, through the kindness of Mr. Harry K. Clench, of the statements in Hall (1930, pp. 38–39) as follows: "*P. batesii* Reak. . . . *Habitat.*—Eastern United States, New York, New Jersey, Pennsylvania, Maryland, Ohio, Virginia, West Virginia, Mississippi. An obscure species, . . . In the British Museum there are specimens from Virginia, 'United States,' and an unusually dark ♂ from Livingstone [sic], Mississippi."

On learning of this, I wrote to Mr. N. D. Riley at the British Museum (Natural History) who replied as follows: "The specimen is in the collection and quite recognizable. The data labels are four in number and are as follows: (1) Printed label 'Livingston / Mississipi / F.D.Godman,' (2) M.S. label: 'Livingston / Mississipi / F.D.G.,' (3) M.S. label: 'ALABAMA,' and (4) Printed label: 'Phycoides batesii Reak. / Godman-Salvin Coll. 1915–3.'" Riley added that the third label was almost certainly written and put on the pin by H. T. G. Watkins. He also added: "I took the liberty of comparing the specimen with our series standing under the name *campestris* and as a result I am not at all satisfied that this alleged Mississippi *batesii* is a *batesii* at all. The pattern of the hindwing is much more like that of *campestris*. . . . We have three *campestris* labelled 'Texas' which match it very well. . . ." Later Mr. Riley wrote again advising that Dr. Lionel Higgins who has been working on *Phyciodes* had also examined the specimen and agreed that it was *campestris*. Riley added: "It appears to have been collected by Godman himself . . . and he was most careful about data. I have not been able to find any record of journeys of his in the Mississippi area, but there is a possibility that I might find something out from one of his two daughters. . . ." Mr. Riley finally forwarded me a letter he received from Miss C. Edith Godman who wrote: "We have no records of my Father's journeys but we find in the Introduction to the *Biologia* the following, which might easily have given an opportunity of his collecting a butterfly in Mississippi. He writes that in Autumn of 1887

'Crossing the Atlantic to New York I took the train to Mexico City, then a 6-day journey' and later 'We left Mexico in the spring of 1888 having been absent from home for about 5 months, and returned to England via California and New York.' He also mentions in connection with specimens for the *Biologia*, 'On arrival in England the various consignments were opened—every specimen labelled with its exact location and the name of the collector attached.'—so this would corroborate the accuracy of the labelling on the specimen which you mention. I hope that these quotations may help to resolve any doubts which you may have had."

So far as I can determine the only place in Mississippi that is named Livingston (or Livingstone) is a post office substation so designated because of its proximity to Livingston Park in the city of Jackson. There is a Livingston in Alabama, located about 12 miles east of the Mississippi–Alabama boundary. On the possibility that a collector might have given the locality name Livingston to a specimen taken somewhat west of there in Mississippi, I wrote to Dr. Ralph L. Chermock at the University of Alabama, explained the circumstances, and invited his comments. His reply included the following: "I would strongly suspect that the specimen . . . has been mislabeled. . . . Livingston, Alabama would be way out of the range for *batesii* or *campestris* . . . there is a Livingston in Montana which would be in the range of *campestris*."

Livingston, Montana is on the main line of the Northern Pacific Railway and is the junction point for the branch line to Yellowstone Park. Elrod (1906) recorded "*Phyciodes pratensis* Behr" and *Phyciodes camillus* Edwards from localities in Montana not far from Livingston. The former is now regarded (dos Passos, 1964) as a synonym of *campestris* and the latter as a subspecies of *campestris*.

From this examination I conclude:

(1) Hall (1930) unfortunately published an erroneous record because of its apparent authenticity.

(2) Watkins probably established that there was no "Livingston" in Mississippi and attempted, incorrectly, to correct the state named on the label.

(3) Someone, possibly Godman, perhaps concluding from the indicated, incorrect, locality label that the specimen came from too far east to be *campestris*, misidentified it as *batesii*.

(4) The original, unfortunate, error occurred when Godman, in what was a most unusual lapse for him, recorded the locality as "Mississipi" when it was not. One is reminded of the difficulties resolved by Burns (1964, pp. 124, 189) concerning the recorded occurrence of two species

in Montana by establishing that the locality labels on the specimens read "Mo." which he noted is "our somewhat irrational abbreviation" for Missouri.

(5) The specimen is almost certainly *P. campestris*[1] and most likely was taken at Livingston, Montana.

(6) No change is indicated in the conclusion that the possibility of the occurrence of *Phyciodes batesii* in Mississippi is so remote as not to merit mention on our faunal lists.

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dos Passos, C. F., 1964. A Synonymic List of the Nearctic Rhopalocera. Lepid. Soc., Memoir No. 1, 145 pp.

[1] On 24 September 1965, while I was visiting at the British Museum, London, Mr. Riley kindly showed me the series of *P. batesii* in that collection. We noted that the Godman specimen was no longer there. Further examination disclosed that the specimen had been moved to the portion of the collection with *P. campestris*. The Godman specimen closely resembles other *P. campestris* from Montana, which are in the British Museum.

A NEW SPECIES OF *GLAUCINA* (GEOMETRIDAE) FROM TEXAS

A. Blanchard
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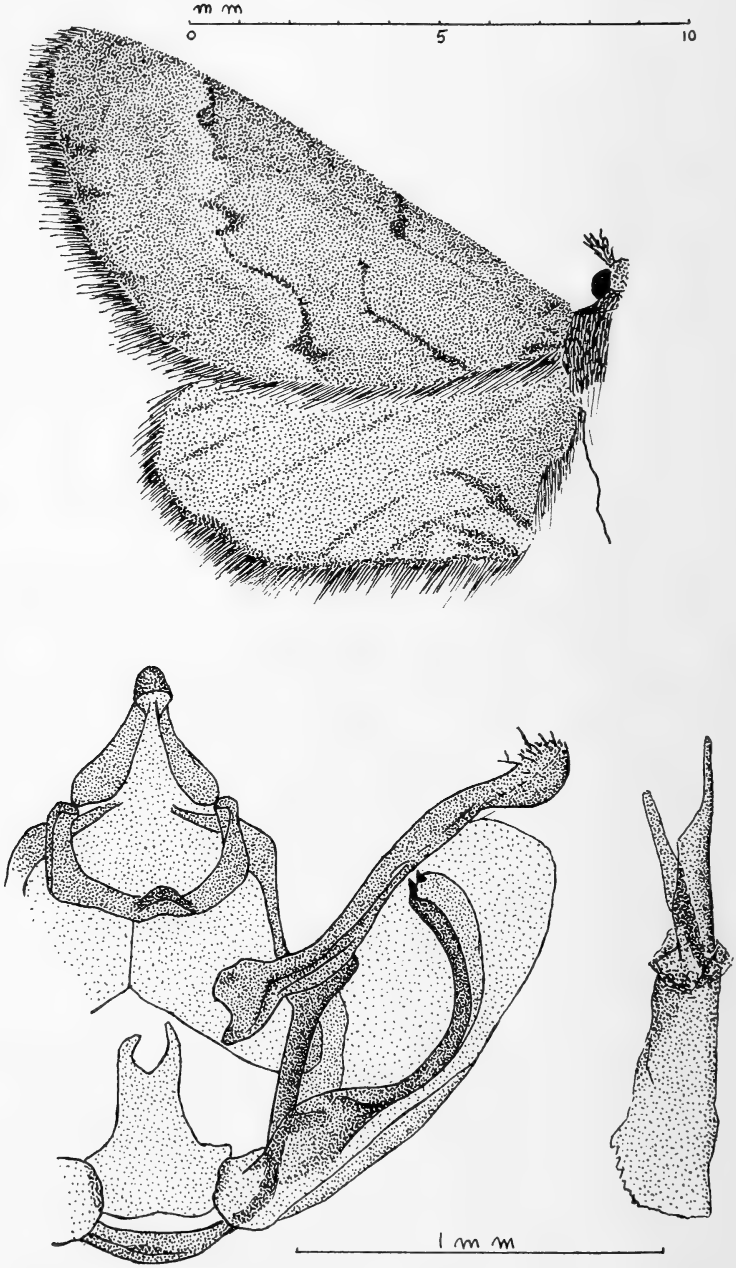
While making genitalic slides of male *Glaucina* specimens, I discovered two which did not agree with any described by F. H. Rindge in his revision of the genus (1959). As the color of the wings of these two specimens is of a more neutral, ashy gray than is the case for most *Glaucina*, and paying attention to the course of the t. p. line, it was easy to select five more male specimens which proved to have similar genitalia. Dr. Rindge, to whom I submitted a sketch of the male genitalia, confirmed my impression that I was dealing with a new species. A description of it follows:

Glaucina mayelisaria A. Blanchard, new species

Male: *Head*: Vertex gray, front rough scaled, gray except dorsolaterally swollen areas covered with black scales; dorsolateral areas more swollen where they meet at top of front than at midlevel of front where they diverge almost reaching eyes, faint indication of ridges laterally along the eyes in lower half of front; palpi long, extending beyond front about half of diameter of eyes, with blackish scaling.



Glaucina mayelisaria A. Blanchard. (upper) Wing pattern of holotype, with lines slightly emphasized. (lower) Male genitalia, ventral aspect with valvae spread, aedeagus removed and shown at right (prep. A. B. no. 215, in author's collection).

Thorax: Above, gray, concolorous with wings; legs and thorax below mottled whitish and blackish; foretibia darker; all tarsi black, narrowly bordered distally with white.

Abdomen: Concolorous with thorax, above and below.

Wings: Upper surface: Forewings, ground color ashy gray, resulting from mixture of light gray and blackish scales, all white-tipped, no tawny or brownish tint; darker in outer third and along costa; t. a. line, sometimes obsolete, generally obscure in upper half, particularly through cell, marked on costa approximately one-third of distance from base, arising again on Cu, two-fifths of distance from base to margin, swinging basad by a well-rounded curve to fold, then straight to inner margin which it reaches barely one-fifth of distance from base; t. p. line, varying from faint in its upper half, mainly facing cell, to well marked from costa to inner margin, in general course parallel to outer margin, dentate on most veins, incurved between veins, most noticeably in fold; t. p. line followed by lighter area; no discal dot; no s. t. line; terminal line fine and black; fringe concolorous with darker portions of wing, except in lower half, appreciably lighter. Hindwings, concolorous, lighter except along the anal margin; maculation absent except a short but prominent fraction of the postdiscal line above anal angle; terminal line and fringe as on forewings. *Under surface*: Forewings pale gray, darker along costa and near apex. Hindwings light gray, with heavy spattering of black specks, producing from a distance same shade of gray as forewings; both wings without maculation except for narrow terminal line; fringes as above.

Length of forewing: 11 to 12 mm.

Male genitalia: Uncus triangular in outline, width of base about equal to length, apex curved ventrally, terminally resembling a flattened hood; gnathos with small median enlargement; valvae broad, rounded apically, indented at junction of costa; costa of even width to apex, slightly sigmoid, dorsally concave in proximal half, ventrally concave in distal half, no median swelling, the upper surface of apex beset with slightly curved, spine-like hairs; sacculus arm long and narrow, of even width, curved in quarter circle so that its tip almost touches costa; tip of sacculus arm provided with two short, thick, heavily sclerotized spines; base of valve with heavily sclerotized band, widened at junction with costa, only slightly widened at junction with sacculus arm; juxta connecting sclerotized sacculus bases; aedeagus, about same length as costal arm, much pointed at distal end and only a half cylinder in its distal two-fifths, proximal half much thicker; vesica armed with single cornutus half as long as aedeagus.

FEMALE: unknown

Holotype, male: Big Bend National Park, Government Spring, Sept. 29, 1965, deposited in the American Museum of Natural History; six paratypes, also collected in the brushy area extending north and west at the foot of the Chisos Mountains, at an altitude of 3,000 to 4,000 feet: Oak Spring Aug. 5, 1964, deposited in the U. S. Nat. Mus.; Oak Spring Oct. 4, 1965, deposited in the Los Angeles Co. Mus.; Oak Spring Oct. 4, 1965, one specimen; Oak Spring Oct. 6, 1965, two specimens; Dugout Wells Sept. 28, 1965, one specimen; the last four paratypes are in the author's collection.

It seems that this species would fit best in Rindge's Group IV, although the key to species groups based on male genitalia limits group IV to species with a straight sacculus arm. Like all species in Group IV, its front presents dorsolaterally swollen areas; but, *infumataria* is the only

other species in this group with t. a. and t. p. lines which do not join to form loops.

The aedeagus also seems quite peculiar. I have found it quite difficult to remove without damaging the manica and pulling the juxta as well.

The species is named for my wife, who is a constant and devoted companion on my entomological collecting trips.

The author wishes to acknowledge with thanks the cooperation and aid of the personnel of Big Bend National Park, particularly Mr. Douglas B. Evans, park naturalist. The author also wishes to thank Dr. F. H. Rindge, American Museum of Natural History, New York, for assistance on this and many other occasions.

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RINDGE, F. H., 1959. A Revision of *Glaucina*, *Synglochis*, and *Eubarnesia* (Lepidoptera, Geometridae). Bull. Amer. Mus. Nat. Hist., 118: 263–365, plates 23–27.

THE FEMALE OF *GLAUCINA MAYELISARIA* A. BLANCHARD (GEOMETRIDAE)

Among some unmounted specimens recently donated to the American Museum of Natural History by Mr. Blanchard were some *Glaucina*. Included with these were four examples of *mayelisaria* collected by A. and M. E. Blanchard from the following Texas localities: 10 miles north of Van Horn, Culberson County, June 24, 1965, and Oak Spring, Big Bend National Park, June 30, 1965. There were two males from the first locality, and one male, one female from the second. As the female of this species is undescribed, the following descriptive notes will be of interest.

The female of *mayelisaria* is very much like the male in size, color, and pattern. There is slightly more pale scaling basad of the t. a. line and distad of the t. p. line than in the holotype. The length of the forewing is 11 mm.

The female genitalia of this species are very distinctive. The sterigmal area is heavily and extensively sclerotized, with a broad, medially invaginated lamella postvaginalis, bordered by a wide, curving anterior band extending farther cephalad than in any known species of *Glaucina*. The ductus bursae is short, weakly sclerotized, and extends more or less dorsally into the membranous corpus bursae. The latter is ovate and relatively small, and does not have a neck. The signum is small and somewhat poorly defined; it has a transverse, inwardly pointing median ridge. The intersegmental membrane between A_7 and A_8 is not modified.

FREDERICK H. RINDGE, *Department of Entomology, The American Museum of Natural History, New York, N. Y.*

A NEW SPECIES OF MOTH DESTRUCTIVE TO PINE CONES IN MEXICO (TORTRICOIDEA)

William E. Miller
North Central Forest Experiment Station, Forest Service, U.S.D.A., St. Paul, Minnesota[1]

Moth specimens sent to me for identification by the Instituto Nacional de Investigaciones Forestales (Mexico) included a species of *Laspeyresia* that is apparently undescribed. Feeding in the cones of Mexican white pine, *Pinus ayacahuite* Ehrenb., its larvae reduce seed yields, thereby hindering forestation efforts. The purpose of the present paper is to name this new species. The biology of this and other Mexican seed-destroying insects is being studied by the Instituto.

Laspeyresia nigra Miller, new species

Length of forewing 8.0 mm. Head, face, labial palpus clothed with white-tipped black scales; collar of shiny black scales. Thorax clothed dorsally with shiny black scales; patagium similarly clothed, except posterior scales faintly lighter toward tips. Ventrally, thorax covered with shiny, dark gray scales. Front leg, tibia and tarsi of middle leg, and tarsi of hind leg clothed with dark gray scales, narrowly tipped with white; remaining leg segments with shiny, dark gray scales. Upperside of forewing (Figure 1a) with shiny black scales in basal fifth; white-tipped, sooty black scales in remainder, except for crossbands. Three lead-colored crossbands present, more or less bordered by black scales: basal crossband crossing wing completely; middle one extending from costa nearly across wing, constricted near center; apical one intermittent, following edge of wing except bending inward near costa. Costa with three small spots of lead-colored scales between apical and middle crossbands. Forewing fringe gray, a black line running along fringe base. Upperside of hindwing sooty black; fringe gray. Undersides of fore- and hindwings dark gray, almost black. Outline of valva as in Figure 2a. (Abdominal coloration not studied before abdomen was cleared and mounted on microslide.)

Holotype, male: Mexico, Tlaxco, Tlaxcala (approximately 19°30′ north latitude, 98°08′ west longitude), February, 1964. The above description is based solely on the holotype male which is labeled: "En semilla *P. ayacahuite*, Tlaxco, Tlax., Feb. 1964; ♂ genitalia slide 378, 5.22.64, C. D. Waddell." The holotype has been deposited in the U. S. National Museum, Washington, D. C. (Type Number 67798).

Besides the holotype, I studied four females from Tlaxco. All had forewings 8.0 mm. long, the same as the holotype. There was virtually no variation in external appearance among the four females and holotype male. However, the lamella postvaginalis (Figure 2c) varied slightly in the outline of its posterior margin. Nomenclature of genital parts follows Klots (1956).

[1] The Station is maintained in cooperation with the University of Minnesota.

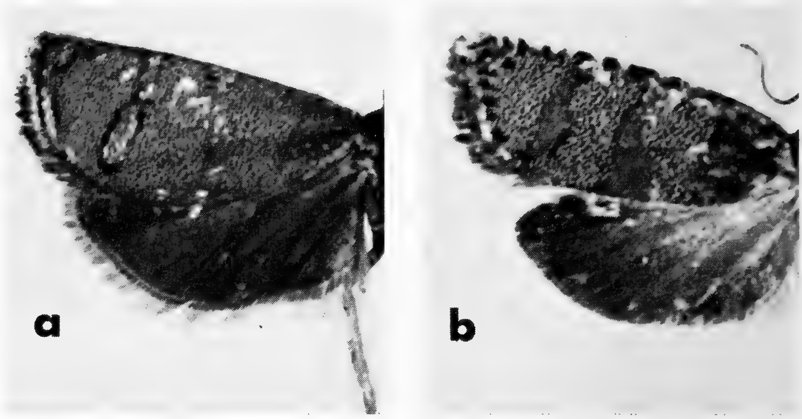

Fig. 1. Wings of *Laspeyresia* species; (a) *L. nigra* Miller, holotype; (b) *L. miscitata* Heinrich.

One of the females, with same label information as the holotype except where noted, is designated the allotype: ". . . . Dic. 1963; ♀ genitalia slide 394, 7.2.64. . . ." and is in the U. S. National Museum.

The adult is strikingly dark—hence the name *nigra*. It is most like *Laspeyresia miscitata* Heinrich (Figures 1b and 2b, d) but is distinguished by the following: absence of white spots along the forewing costa; darker hindwings, particularly the fringe; more heavily sculptured

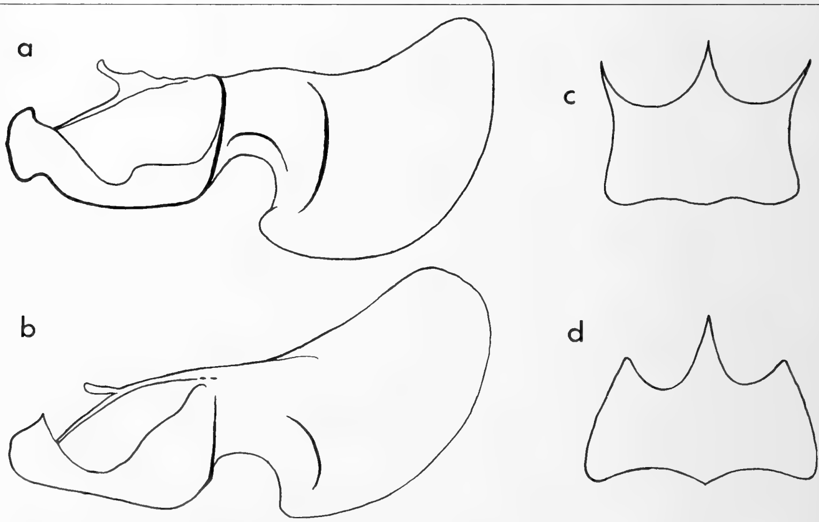

Fig. 2. Outline of genital parts of *Laspeyresia* species; (a) valva of *L. nigra* Miller, holotype; (b) valva of *L. miscitata* Heinrich, holotype; (c) lamella postvaginalis of *L. nigra*; (d) lamella postvaginalis of *L. miscitata*.

valva with less opening in proximal area; less anteriorly tapered lamella postvaginalis. Also, the aedeagus of the *L. nigra* holotype has 13 cornuti and is about one and a half times longer than the aedeagi of *L. miscitata* males examined (holotype and three paratypes) which have only 4 to 8 cornuti. The taxonomy of other North American seed-feeding *Laspeyresia* moths affecting pine is discussed by Heinrich (1926) and Miller (1959).

The one known host of *L. nigra*, Mexican white pine, belongs to the *Haploxylon* or soft pine subgenus while the hosts of *L. miscitata*, *Pinus ponderosa* Laws. and *P. jeffreyi* Grev. and Balf. (Keen, 1958), are members of the *Diploxylon* or hard pine subgenus.

ACKNOWLEDGMENT

I am grateful to Maria Luisa Estébanes G., of Coyoacan, D. F., Mexico, for supplying data and examples of the new species.

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BUTTERFLIES OF YAKIMA COUNTY, WASHINGTON, ADDITIONS AND CORRECTIONS

E. J. NEWCOMER
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After the "Butterflies of Yakima County, Washington" was published (Newcomer, 1964), two additional species were taken in the county. Through the cooperation of the U. S. Bureau of Indian Affairs I was issued permits to collect on the Yakima Indian Reservation in 1964 and 1965. Much of the restricted area of the Reservation is heavily forested with *Pinus ponderosa* and other conifers. Collecting is not very good in heavy forest except in the occasional open meadow.

Signal Peak, about 15 miles east of Mt. Adams,[1] has an elevation of 5,111 feet, and above 4,800 feet much of it is open and grassy with many

[1] This would place it on the map (Newcomer, 1964) about halfway between Nos. 20 and 24.

wild flowers. Collecting is good here. The following two skippers were taken at this location (determined by Dr. C. Don MacNeill, Oakland, Calif.):

104. *Hesperia nevada* (Scud.). Signal Peak, June, July. This is the first record for the State of Washington. Common.

105. *Polites mardon* (Edw.). Signal Peak, July 6, 1964 and June 9 to July 15, 1965. Fairly common on grassy slopes, the females often feeding on blossoms of dandelion and wallflower (*Erysimum capitatum* (Dougl.), the males usually resting on rocks or bare ground. Stanley Jewett reports having taken two males on Mt. Adams above Bird Lake, elevation about 6,500 feet, August 8, 1955. The type locality is Mt. Hood, about 60 miles southwest of Signal Peak. It has also been collected at Seattle and Grand Mound, in Western Washington. The larvae are known to feed on grass and a probable foodplant here is *Festuca ovina* L.

CORRECTIONS

P. 217, line 17. *Erebia discoidalis*, should be *epipsodea*; a *lapsus* on my part.
P. 218, No. 14. Should be Ahtanum Creek.
P. 219. Caption for map should read "Numbers 1–24."
P. 221. 14. *Euchloe creusa*. Paul Opler, University of California, Berkeley, tells me that this species is *E. hyantis lotta* (Beut.). This new combination is established by him (Opler, 1966). Typical *creusa* is a subarctic species which may not occur in the United States, exclusive of Alaska. *E. h. lotta* flies to some extent with *ausonides*, but is more likely to be found on the open sagebrush desert where annual crucifers grow.
P. 223. 42. *Chlosyne hoffmanni manchada*. The foodplant has been found to be *Aster conspicuus* Lindl. The early stages are described elsewhere (Newcomer, 1967).
P. 228, line 2. *Euphydryas anicia*.

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CORRECTION

McElvare, R. R., 1966. New Heiliothid moth from the southwestern United States. Jour. Lepid. Soc., 20(2):91–94. The date given for the holotype of *Grotella blanchardi* on page 93, September 17, 1963 is correct; that given in the explanation of the plate on page 92 (September 9, 1963) is in error.—ROLAND R. MCELVARE, *Southern Pines, North Carolina.*

NICHOLAS SERGEEVICH OBRAZTSOV, 1906–1966

On the 6th of May, 1966 Dr. Nikolaï (Nicholas) Sergeevich Obraztsov died unexpectedly of heart failure in Sea Cliff, Long Island, near New York, at an age of 59. He was the leading specialist of the Tortricoid Microlepidoptera.

Nikolaï S. Obraztsov was born on 18 August 1906 in Rostov on the Don, Russia, second son of Dr. Sergei Nikolaëvich Obraztsov, physician and later university professor of pathological anatomy, and of Ludmila Nikolaëvna Obraztsova. He lived in Rostov until 1922, where he finished the classical gymnasium. In that year he moved to Nikolaev also in southern Russia, where he studied natural history, science, chemistry, and mathematics at the Institute for Pedagogy, a course which he finished in 1934. In 1926 he was appointed lector in Zoology at Nikolaev. In 1934 he moved to Kiev, where he married Vera Nikolaëvna Obraztsova. From this marriage a son and a daughter were born. In Kiev, Obraztsov was lector of biology at the Medical Institute of the University until 1937, and assistant at the chair of Zoogeography of the University until 1938. From 1937 through 1940 he also was keeper of Lepidoptera at the Zoological Museum of the University.

In 1940 he and his family were deported by the German army to Germany. In 1944 Obraztsov was appointed Lepidopterist at the Zoological Institute of the University of Königsberg. From 1946 until 1951 he worked at the Zoologische Sammlung des Bayerischen Staates at Munich. In that year he received the degree of Ph.D. at the Faculty of Natural Sciences of the University of Munich.

In 1951 the Obraztsov family emigrated to the United States and took residence in Sea Cliff, New York. In New York Obraztsov became Research Associate of the American Museum of Natural History and of the United States National Museum at Washington, D. C., with research grants from the East European Foundation of the N.S.F. The subjects of his research were revisions of the family Ctenuchidae of the World and of the family Tortricidae, first of the Palaearctic, later of the Nearctic and Neotropical regions.

Dr. Obraztsov died suddenly of coronary thrombosis after a few days of illness. He died in harness: with unsorted colour slides of type specimens still piled on his table and unfinished manuscripts neatly put away in a filing cabinet. It is hoped that parts of his unfinished work can be completed through the efforts of his colleagues, A. Diakonoff and J. A. Powell.

From his early years Nicholas Obraztsov was a serious and eager boy and showed great interest and love for living things in nature; soon he started observing, collecting and studying insects, especially butterflies. Through his school years he was a zealous pupil and a great reader. He collected considerably around Kiev and also made collecting expeditions through southern Russia as far as the Caucasus. Later, however, he gave up all collecting, and dedicated himself entirely to taxonomy. He started correspondence with many Russian lepidopterists. One of them, Dr. Leo A. Sheluzhko, of Kiev, who was the owner of the greatest private collection of Lepidoptera in U.S.S.R. at the time, had a great influence upon the scientific development of Obraztsov. Sheluzhko soon invited him to see his famous collection. Obraztsov came and lost himself entirely in Lepidopterology, resolved to move to Kiev and to dedicate himself to this branch of study. Later he left other groups of Lepidoptera and concentrated on the Tortricoidea.

Besides his local south Russian contacts, Obraztsov visited the Zoological Institute of the Academy of Sciences at Leningrad several times and there met the leading Russian Lepidopterists: N. J. Kusnezov, A. M. Djakonov, and N. N. Filipjev. His private collection of Lepidoptera was donated to the Zoological Museum of the Kiev University where also finally went the great Sheluzhko collection. Obraztsov's notes and card

indices were lost during the World War II and had to be remade after the war.

Obraztsov's scientific importance is considerable, in spite of relatively limited time he was able to devote himself fully to the study of the systematics and taxonomy of the Tortricoidea; and in spite of the handicaps and hardships of life in post-war Germany, where he laid the foundation for his great card catalogue.

The systematics of this group of Microlepidoptera had become a complete chaos, due to lack of application of genitalic studies and to lack of coordination of the work of students in continental Europe, England, and North America. The great backlog of knowledge of an enormous body of literature, chiefly on the Palaearctic fauna, over a long period of time, resulted in serious lack of trustworthy and comprehensive literature surveys which would make the knowledge accessible. During many years nobody seemed to have enough courage, insight, time, and diligence to unravel this mountainous knot. Then Obraztsov appeared and undertook this endeavour: of lepidopterological "book keeping." He quietly and steadily devoted every free hour of his time for many years to studying the literature from Linnean times on, a project which continued until shortly before his death. He not only remade his lost card indices of genera and species but extended his Catalogue to an immense scope, including the Tortricoidea of the whole world and so became the recognized leading specialist of the group.

The card index, arranged alphabetically, contains cards of genera, species, and lower taxa. Besides, many cross-reference cards, pertaining to all ever used binominal combinations, and finally, an index catalogue of all separate names. The great work comprises of about 30,000 typed cards.

Drawing from this deep well of information Obraztsov could readjust genera and species, detect synonymies, sink and revive names. Students of Tortricidae, especially of the Palaearctic fauna, which has been the most confused, depended upon his word for taxonomic, systematic, and nomenclatory information.

The chief result of the Catalogue was the publication of the series "Die Gattungen der Palaearktischen Tortricidae," which appeared in parts in the *Tijdschrift voor Entomologie* from 1954 onwards. Unfortunately this extensive revision has not been completed. The subfamilies Tortricinae and Sparganothidinae have been finished, but of the Olethreutinae only the first tribe, the Laspeyresiini has been completed, while the Eucosmini is in the progress of publication. Manuscripts of several additional parts have been found after his death and will be pub-

lished, as far as possible. Fortunately we know his concept also of the Eucosmini and that of the Olethreutini, not only from additional stray papers but chiefly from the work of H. J. Hannemann, *Die Wickler*, in Dahl's *Tierwelt Deutschlands*: Obraztsov provided the taxonomic base for this important publication. The Catalogue of the Tortricoidea thus forms a Key to Dr. Obraztsov's great Scientific success. It is the plan of the American Museum of Natural History, where the catalogue will be deposited, to try and publish it, in order to make it widely available to lepidopterists.

After his basic studies of the Palaearctic fauna Obraztsov took up the Nearctic Tortricidae, the chief subject of the N.S.F. grants, and unavoidably was also very much attracted by the fascinating Neotropical fauna. Only recently he discovered the presence of the subfamily Chlidanotinae in South America, new for that fauna.

Not in possession of own collection and being dependent on the materials which he continuously borrowed from many museums, he searched for a means to fix received information and to form an archive for reference. So he started with a second card index, that of negatives and black and white prints of the wings and the genitalia.

Parallel to this he recently started a third catalogue, that of colour slides of type specimens of the Tortricoidea, which he photographed during visits to museums in the U. S. and abroad. Probably this would have become his most important tool. Modern 35 mm colour film shows colour and every detail of the insect with so great perfection, that studying them with a low power microscope almost equals investigating the original type specimen. Here was a chance to have at one's disposal a complete collection of replica of the types scattered over many museums and collections. Obraztsov was so enthusiastic about this project that he made over 1,000 colour slides during his last two months stay at the British Museum in London.

Along with these studies he had large correspondence and determined material for many colleagues and collectors, chiefly in Europe and Japan, but lately also in the United States.

Obraztsov's diligence and working capacity were amazing. He worked unobtrusively most of the time; he worked Sundays and during his leave. But he was certainly not a monomaniac, on the contrary: remarkably, he could also find time for reading of an amazing amount of books on most diverse subjects; his house is overflowing with them. But his chief hobby was music: listening to it and collecting it on records and tapes. He also was a good technical photographer, with a well-equipped darkroom, and an enthusiastic amateur movie camera operator. He had a talent for lan-

guages and published alternately in English and German.

At home Dr. Obraztsov was a kind, attentive, and considerate man, quiet and equanimous, always ready to help everyone with deed and advice. He had a great number of friends, valued these friendships highly and much enjoyed inviting and entertaining his friends. He was also a thoughtful and devoted head of the family. But his scientific work doubtless was the most important part of his life: he chiefly thought of it, lived for it, and was contented and happy so long as he could indulge in it.

With his death the great machinery of Obraztsov's work comes now to a stop. As so many colleagues were dependent on his advice, many will keenly miss him. And those who had the privilege to know him close and intimately feel the loss the more deeply, with bewilderment and sadness. For nobody had ever expected that he would leave the world so suddenly instead of dedicating many more fruitful years to his beloved Tortricidae.

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(New name in **boldface**; synonyms in *italics*)

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Volume 21 1967 Number 1

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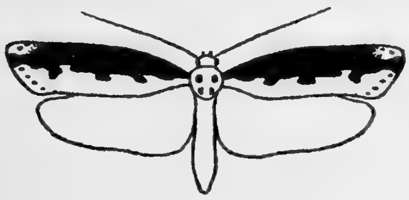

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21 February 1967

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

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In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

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JOURNAL OF THE LEPIDOPTERISTS' SOCIETY

Volume 21 | 1967 | Number 1

ON THE YELLOW FORMS OF *COENONYMPHA TULLIA* (SATYRIDAE) IN OREGON

ERNST J. DORNFELD[1]

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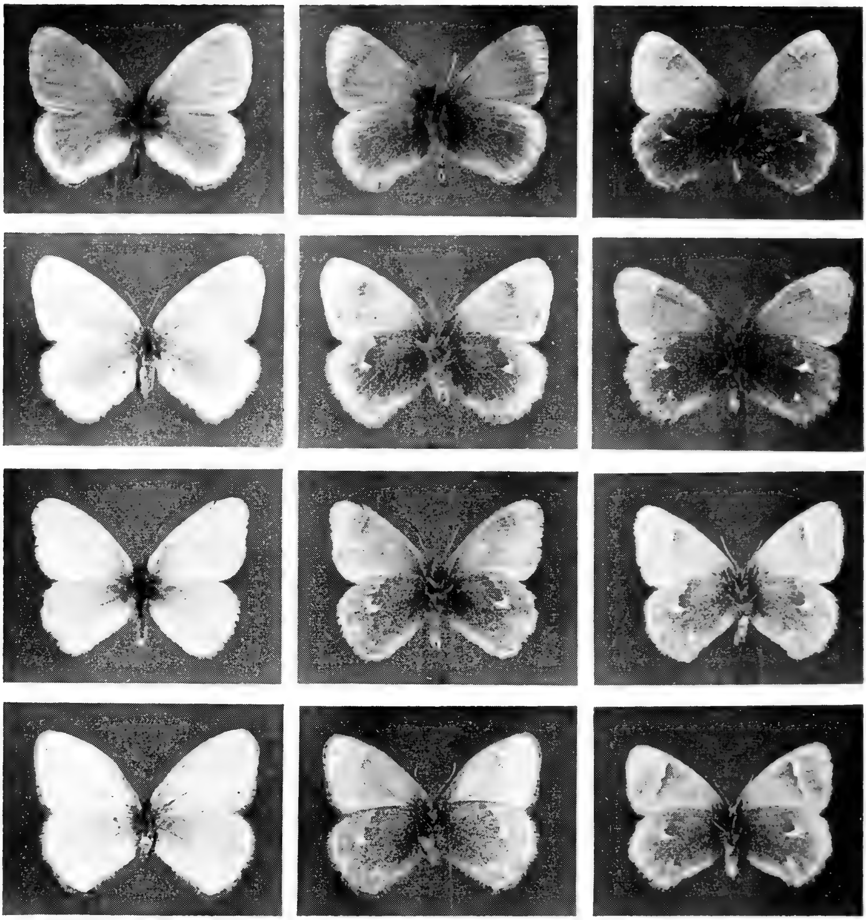
The genus *Coenonympha* is represented in Oregon by both white and yellow forms of the *tullia* complex. Populations of the white ringlets occur in the southwestern counties of the state and are allied to *california* Westwood. Elsewhere they are replaced by yellow forms (see fig. 1). The identification and relationships of these yellow populations have been much confused, largely, it seems, because of insufficient acquaintance with adequate samples and with the features of their geographic distribution and their seasonal dimorphism.

The first point of note lies in the phenotypic distinctness of the eastern and western populations, the zone of separation being the Cascade Range. Contrary to some published implications (e.g., Davenport, 1941), there is no good evidence that these two population groups overlap or that they show clinal intergradation or natural hybridization. They display essentially different spectra of phenotypic variability.

The western populations (plate I) have been generally referred to *Coenonympha ampelos,* which Edwards described in 1871 from two specimens taken in "Oregon," exact place and date undesignated. In the light of Brown's recent study (1964) of the extant female lectotype (Canadian National Collection), this usage must be abandoned. The lectotype bears no resemblance to any ringlet from western Oregon, but it does match summer brood material from east of the Cascades (Brown, personal communication). It may have been collected by William Gabb near the California border of what is now Lake County, Oregon.

In 1937 Field, believing that Edward's *ampelos* applied to the second brood of the western ringlets, introduced the name *eunomia* for the first generation. As an infra-subspecific term ("A New Seasonal Form . . .")

[1] I am indebted to Mr. F. Martin Brown for critical comments on the problems treated in this account; also to Mr. William D. Field for assistance in the location of type specimens.



EXPLANATION OF PLATE I

Coenonympha tullia eunomia Dornfeld, (Western Oregon)

Top row: First generation males. Left to right: McDonald Fst., Benton Co.; same, ventral; Gales Creek, Washington Co. *Second row*: First generation females. Left to right: Alsea, Benton Co.; same, ventral; McDonald Fst., Benton Co. *Third row*: Second generation males. Left to right: Corvallis, Benton Co.; same, ventral; Corvallis, Benton Co. *Bottom row*: Second generation females. Left to right: McDonald Fst., Benton Co.; same, ventral; Corvallis, Benton Co.

eunomia is not eligible for subspecific use under the original authorship and date (International Code of Zoological Nomenclature, Art. 45, d, iii). The name, however, is unambiguously associated with the populations under consideration, and its retention is desirable. Therefore, in recognizing these populations as a distinct subspecies of *C. tullia*, I here apply

to this subspecies the name *eunomia* and designate the types established by Field as those of this subspecies.

Coenonympha tullia eunomia Dornfeld, new subspecies

MALE.—Length of forewing 14.1 to 17.9 mm. *Forewing*: dorsally ochraceous in first generation and immaculate, hairy black scaling at base, lateral fringes black at inner margin; second generation lighter above, approaching buff, little or no black scaling, slight development of yellow vertical ray across upper half of extra-discal area. Ventrally, first generation with orange-brown flush in discal area, apices and lateral margins appearing greenish-gray through broad dusting with black and white scales, non-ocellated, extra-discal vertical ray usually limited to upper third of wing or absent; second generation with light brown discal area, greenish apex and margin repressed or absent, development of ray more pronounced. *Hindwing*: dorsally like forewing; ventral ground color ferruginous in first generation, with heavy overlay of black scales common, margins and base greenish-gray, basal scales very hairy, extra-discal vertical ray extending from costa to end of cell or absent; second generation with ground color light brown, generally without greenish margins, basal scales less hairy, often with fuller development of vertical ray.

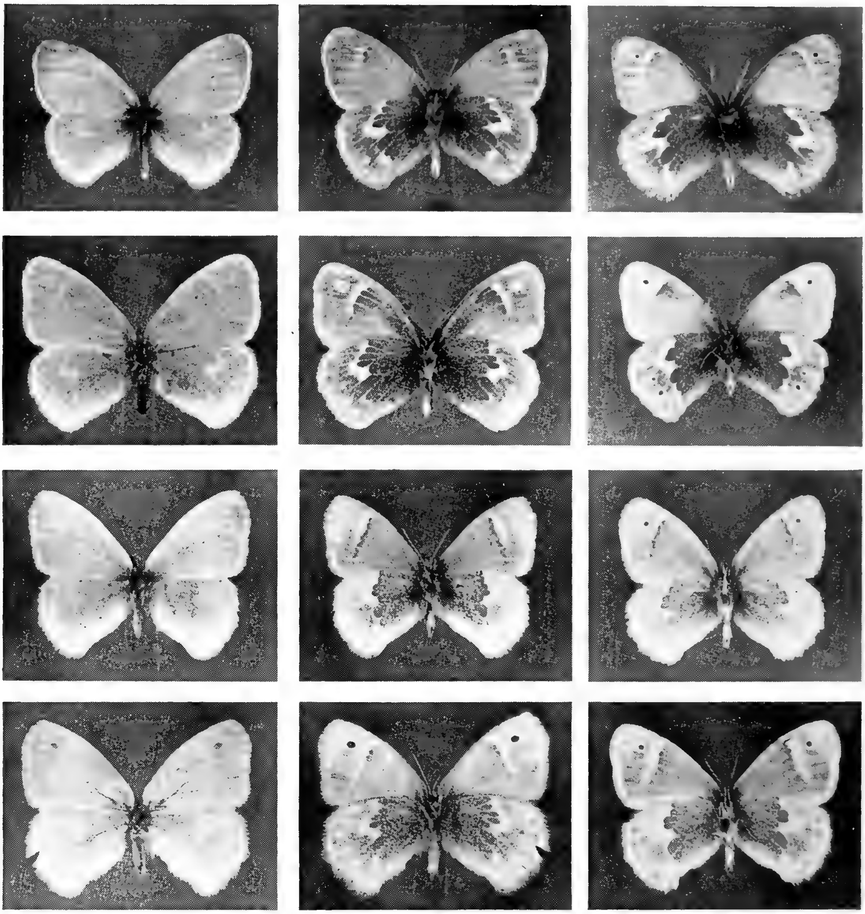
Female.—Length of forewing 14.8 to 17.9 mm. Essentially as described for male; wing shape more obtuse, averaging slightly lighter in ground color above and below, vertical ray tending to have small post-cellular component on ventral hindwing especially in second generation.

Type series (originally designated as *C. ampelos* gen. vern. *eunomia* Field) as follows:

Holotype, male, and allotype, female, Wilhoit, Clackamas County, Oregon, June 6, 1937 (C. W. Herr). *Paratypes* #1 male, McMinnville, Yamhill Co., Ore., May 16, 1931; #2–9 and 11–20 males, Wilhoit, Ore., June 6, 1937 (Herr); #10 female, Oregon, May 24; #21 male and #22 female, Portland, Ore., May 10, 1934; #23–29 males, Oregon, May 21–25.

The holotype, allotype, and paratypes #1, 5–13 and 21–26 are deposited in the U. S. National Museum; the holotype bears the U.S.N.M. type number 34795. Paratypes #2 and 18–20 are in the Canadian National Museum. Paratypes #3 and 4 are in the Los Angeles Museum. Paratypes #14–17 and 27–29, originally in the collection of C. W. Herr of Woodburn, Oregon, appear to be no longer extant.

OREGON RECORDS (see fig. 1) as follows. BENTON CO.: Alsea, 5/vii/52 (Dornfeld); Corvallis, numerous records vi to ix (Dornfeld); McDonald Fst., numerous records v to ix (Dornfeld); Alsea Fish Hatchery, 31/v/64 (Dornfeld); Mary's Peak, 10/vi/61 (Dornfeld). CLACKAMAS CO.: Oak Grove, 20/iv/34 (Jewett); Estacada, 10/viii/34 (Jewett); Mouth of Eagle Cr., 14/vi/53, 11/ix/53 (Jewett); Barton, 15/v/60, 4/vi/61 (Jewett), 1/x/61 (Crowe); Wilhoit, 6/vi/37 (Herr) type series. LANE CO.: Hills Creek Dam Rd. 13/vi/64 (Dornfeld); Fern Ridge Reservoir, 31/vii/58 (Woodley). LINN CO.: Cascadia, 12/viii/57, 23/v/59, 10/vi/62, 28/vi/64 (Dornfeld); Brownsville, 17/ix/07 (Wilson). MARION CO.: Silver Cr. Falls St. Park, 22/vi/57 (Jewett). MULTNOMAH CO.: Portland, 14/iv/34 (Jewett), 27/vi/57 (McCorkle), 8, 17/viii/61, 12, 22/ix/61 (Crowe); 13/viii/61 (Dunn). POLK CO.: 5 mi. W of Monmouth, 30/v/64 (McCorkle); Monmouth, 18/ix/64 (McCorkle).



EXPLANATION OF PLATE II

Coenonympha tullia ampelos Edwards, (Eastern Oregon)
Top row: First generation males. Left to right: Owyhee R. nr. Three Forks, Malheur Co.; same, ventral; Viewpoint Rd., Ochoco Mts., Crook Co. *Second row*: First generation females. Left to right: Devine Cn., Harney Co.; same, ventral; nr. Warm Springs, Jefferson Co. *Third row*: Second generation males. Left to right: Frenchglen, Harney Co.; same, ventral; Frenchglen, Harney Co. *Bottom row*: Second generation females. Left to right: nr. Hines, Harney Co.; same, ventral; Emigrant Cr., Harney Co.

WASHINGTON CO.: 3 mi. N of Hillsboro, 22/viii/61 (Ludwig), 3/ix/61 (Crowe); Gales Creek, 22/vi/65 (Ferguson). YAMHILL CO.: Sheridan, 23/ix/61 (Crowe); McMinnville, 19/vii/29 (Fender); Dayton, 3/vii/37 (Aldrich).

This subspecies, *C. tullia eunomia* (plate I), inhabits the Willamette Valley of western Oregon and ranges northward into Washington. It is

double brooded and the wings are totally devoid of ocellations. Seen in series, the first generation specimens have a dorsally darker cast than those of the eastern Oregon ringlets, and the males possess a wider zone of black scaling at the base of the wings. Ventrally, the secondaries tend to be darkly ferruginous in ground color except for a peripheral zone of white and black scales which produce a gray-green marginal effect, also seen on the apices of the forewings; the basal and body scales are very hairy; and the yellow-bordered vertical rays crossing the middle of the fore- and hindwings are greatly reduced and sometimes absent entirely. The late summer generation is characterized by a lighter ground color dorsally; the likewise lighter ventral surface is tannish brown and practically devoid of greenish margin; and the vertical rays tend to be more fully developed.

Coenonympha tullia ampelos Edwards, 1871

The yellow ringlets east of the Cascades (plate II) differ substantially from *eunomia*. While there is variation between individuals, the range of this variability is much the same in all populations. A dimorphic condition, as in *eunomia*, exists between early and late broods. These ringlets, as discussed above, must now be regarded as *C. tullia ampelos* Edwards. Their apparently close relationship to *C. tullia elko* Edwards (northern Nevada) remains to be clarified, but in any case, *ampelos* is the older name and was applied to Oregon specimens.

The first brood of these ringlets from east of the Cascades has the following characteristics. The wing coloration dorsally is lighter than in *eunomia*. Ventrally, all populations include a majority of individuals (about 80 percent) in which ocellations are variably developed on both fore- and hindwings; the ground color of the secondaries is basically gray-green rather than ferruginous, due to heavy dusting with black scales; the vertical rays tend to be strongly developed and widely bordered with yellow. The second, or late summer, generation of this butterfly is, as in the case of *eunomia*, a paler form, and generally less abundant than the first. The wing color ventrally is particularly distinctive, being almost straw yellow, with sharp restriction of the black scaling usually to the discal region, hence little or no suggestion of a green hue. The ocellation pattern resembles that of the first generation, as does the development of the rays which often reaches completion.

Oregon Records (see fig. 1) as follows. Baker Co.: Baker, 21/vi/56 (Baker); Durkee, 7/ix/40 (Motley), 13/vi/47 (Aldrich), 15/vi/62 (Shepard); nr. Huntington, 18/v/58 (Baker); Spring Cr. NW of Baker, 10/vi/56, 12/vi/60 (Baker); Pine Cr. NW of Baker, 7/vii/63 (Aldrich); North Pine Cr. nr. Halfway, 10, 20/vi/59 (Jewett); Indian Cave, 25/v/64 (Crowe); Burnt R., 24/v/64 (Crowe). Crook Co.: Cornez

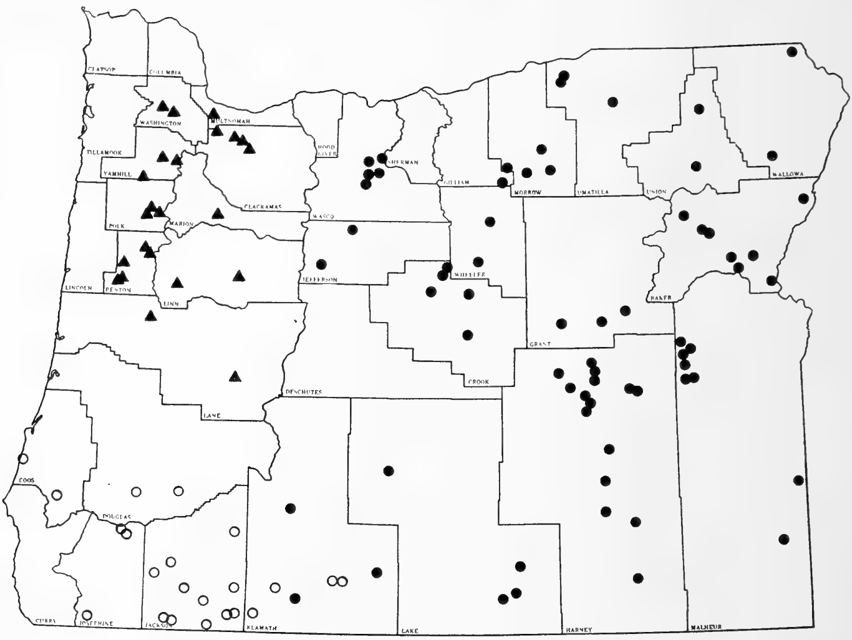


Fig. 1. Distribution of *Coenonympha* in Oregon. Solid triangles indicate *C. tullia eunomia*; solid circles indicate *C. tullia ampelos*; open circles indicate *C. tullia eryngii.*

Cr., 19/vi/58, 22/vi/59 (Dornfeld); Viewpoint Rd. off Marks Cr., 8/vii/60, 2, 12/vii/61, 14/vii/65 (Dornfeld); 16 mi. E. of Prineville, 7/vi/58 (Jewett); Big Summit Pr., 8/vi/58 (Jewett), 1, 6/vii/63 (Aldrich); Maury Mts., 15/vii/64 (Newcomer). GILLIAM Co.: Lonerock, 7/vi/61, 8/viii/61 (Bauer). GRANT Co.: Izee, 2/v/34 (Jewett); Bear Cr., 7, 9/vii/64 (Crowe); nr. Seneca, 5/vii/64 (Crowe), 12/vi/47 (Aldrich). HARNEY Co.: Frenchglen, numerous records v to viii (Jewett, Dornfeld); Blitzen Valley 16/v/36 (Jewett); Malheur Refuge Hdq., 22/v/56 (Hansen); Alvord Hot Spg., 28/v/60 (Jewett); Burns, numerous records v, vi & viii (Crowe); nr. Hines, 7, 16/viii/64, 5/ix/64 (Crowe); Cricket Cr., 22/v/64, 7/viii/64 (Crowe); Devine Cn., numerous records v to viii (Crowe); Stancliffe Cr., 16/v/64 (Crowe); Deer Cr., 16/v/64 (Crowe); Buchanan, 25/vi/64 (Crowe); Emigrant Cr., 20/viii/64 (Crowe); Stinkingwater Mt., 25/vi/64 (Crowe); Silvies R. Dam, 14/viii/64 (Crowe); Fish Lake, 15/vii/53 (Aldrich), 18/vii/64 (Crowe). JEFFERSON Co.: Warm Spgs., 14/v/54 (Jewett), 27/iv/64 (Crowe); Metolius R., 11/vii/52 (Jewett). KLAMATH Co.: Hwy 232 at Sand Cr., 10/vii/62 (Dornfeld); Bly, 13/vi/45 (Aldrich); Klamath Falls, 18/viii/38 (Jewett). LAKE Co.: Hart Mt., 9/vii/37 (Jewett); Adel, 12/vi/62 (Newcomer); Crump L., 23/vii/64 (Newcomer); Silver Lake, 26/v/57 (Aldrich). MALHEUR Co.: C-Ranch, 19/v/58 (Storm); Owyhee R., 21/v/58 (Storm); Jordan Valley, 30/v/60 (Jewett); Beulah Dam, 26/vi/64 (Crowe); Beulah Reservoir, 26/vi/64 (Crowe); 5 mi. E of Beulah Dam, 27/vi/64 (Crowe); nr. Juntura, 28/vi/64 (Crowe). MORROW Co.: Rock Cr. S of 8-Mile, 7/vi/61 (Bauer); Hardman, 29/vi/61 (Bauer); Willow Cr. S of Heppner, 30/vi/61 (Bauer); Cutsforth Mdws., 9/vii/61 (Bauer). UMATILLA Co.: Hermiston, 11/v/61 (Goeden); 10 mi. E of Pendleton, 1/vi/60 (Jewett); Hinkle, 29/iv/60 (Jewett). UNION Co.: 15

mi. S of La Grande, 10/vi/65 (Goeden); Elgin, 18/viii/37 (Jewett). WALLOWA Co.: Wallowa L., 25/vii/64 (Shepard); Horse Cr., 28/vi/64 (Shepard). WASCO Co.: nr. Sherar Falls, 17/v/53 (Jewett); Juniper Flat, 26/v/64 (Newcomer); nr. Tygh Valley, 20/vi/64 (Newcomer); Wapanitia, 10/vi/57, 16/vi/61 (Aldrich); Maupin, 5/ix/60 (Woodley). WHEELER Co.: Mitchell, 17/v/62 (Goeden); Horseshoe Cr., 8/vi/61 (Bauer).

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BOOK REVIEW

A LIST OF THE BUTTERFLIES OF MALAWI, by D. Gifford, 1965. The Society of Malawi, Blantyre, Malawi, Africa. 151 pp., 12 figs., 9 colored plates, 1 map. 50 shilling sterling (=$7.00).

This is the first comprehensive list of the butterflies of Malawi (formerly Nyasaland) ever compiled and is therefore an important contribution to knowledge of the African fauna. The author, now with the University of Edinburgh, spent five years in Malawi as a forester and has a good understanding of the local ecology and butterflies.

The book is arranged as a running key to facilitate identification, a scheme that can be disasterous: in this case it is excellent. Distributional and bibliographic data are given for each of the 531 species listed. The valvae of 12 species of Lycaenidae are figured and there are good colored photographs of about 142 species from all families. The index and bibliography running to 20 pages add greatly to the value of this book as a reference.

Gifford has taken the proper step by reducing most names of sexual and seasonal variants, genetic oddities and "forms" to treatment in the discussion paragraphs, though a few persist in the main list. The revi-

sionary work of Evans for the Hesperiidae, Klots for the Pieridae and Stempffer for the Lycaenidae have been followed; nomenclature in the Papilionidae and Nymphalidae has also been brought reasonably well up to date.

The type faces are readable, though a little small, and careful editing is evident. This book should be in the hands of all lepidopterists and of all those interested in the African fauna. It may be obtained by sending the remittance to Mr. John D. Handman, Secretary, the Society of Malawi, Box 449, Blantyre, Malawi, Africa.

R. M. Fox, *Carnegie Museum, Pittsburgh, Pa.*

SYNONYMY OF *LEUCOPHLEBIA LINEATA BRUNNEA* (SPHINGIDAE)

Leucophlebia lineata brunnea was described in 1915 by A. Closs[1] from Formosa. In 1936 B. Preston Clark, also from Formosa, described *Leucophlebia lineata formosana*.[2] The type of the former is deposited in the collection of the "Deutsches Entomologisches Institut" in Eberswalde (German Democratic Republic); the type of the latter, with the rest of Clark's worldwide sphingid collection, in the Carnegie Museum in Pittsburgh, Pennsylvania.

In order to be sure that the types are representative of one and the same population, the type of *brunnea* was compared in Pittsburgh by the writer with the type of *formosana*. Both were found to represent the same entity.

The name *Leucophlebia lineata formosana* B. P. Clark, therefore, is synonymous with *Leucophlebia lineata brunnea* Closs.

I wish to thank Dr. G. Friese, German Entomological Institute, for having effected the loan of the type specimen of *brunnea* to me.

J. C. E. RIOTTE, *Royal Ontario Museum, University of Toronto, Ontario, Canada.*

[1] Closs, A., 1915. H. Sauter's Formosa-Ausbeute, Sphingidae (Lep.). Suplementa Entomologica, 4: 1–3 (Berlin).

[2] Clark, B. P., 1936. Description of twenty-four new Sphingidae and notes concerning two others. Proceedings of the New England Zoölogical Club, XV: 71–91 (Cambridge, Mass.).

A NEW NEARCTIC SPECIES OF *EXOTELEIA* WALLENGREN (GELECHIIDAE) ON PINE

THOMAS N. FREEMAN
Entomology Research Institute, Canada Dept. Agric., Ottawa, Ontario, Canada

During the past few years various officers of the Canadian Forest Insect Survey have been studying the *Exoteleia* species on pine. One of these, a new species, is described here to enable Mr. O. H. Lindquist, Forest Insect Laboratory, Sault Ste. Marie, Ontario, to deal with its life history in a companion paper that follows.

Exoteleia nepheos Freeman, new species

Exoteleia sp. Freeman, 1960, Can. Ent. Suppl. 16: 24, fig. 14.

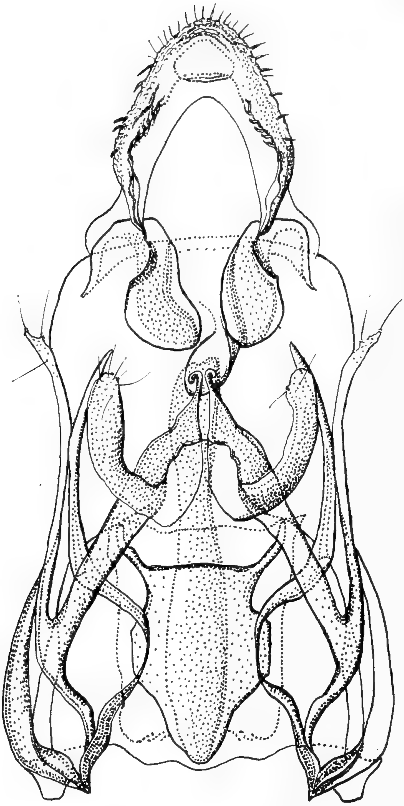
Colour.—Antenna with alternating black and whitish bands. Palpus with black and pearl-white bands. Head, thorax and patagium shiny steel-grey. Forewing golden brown with three greyish and white granular transverse fasciae; extreme base greyish, granular, extending narrowly along costal and anal regions; first fascia at basal third, margined inwardly with scattered white scales intermixed with black scales below fold; second fascia similarly marked but in addition containing a black spot outwardly below fold; third fascia at apical four-fifths, white; costal, apical, and trailing edges greyish; fringe dark grey. Hindwing blackish; fringe dark grey. Legs with black and white bands. Abdomen purplish black.

Wingspread.—9–11 mm.

Male genitalia (Fig. 1).—Very close to those of *E. pinifoliella* Chambers (Fig. 2). Uncus subconical; inner chitinous margin arcuate, not angular as in *pinifoliella*. Gnathos a central, broad, hook-like process with two basal lobes. Clasper with bulbous base and tapered apex. Vinculum complex; two lateral, narrow, membranous processes; two curved sicae; two subtriangular plates with knob-like apices. Aedeagus tubular.

Female genitalia (Fig. 3).—Anterior apophyses short, stout. Posterior apophyses long, narrow. Ostium semicircular; V-shaped in *pinifoliella*.

Holotype, male, Port Burwell, Ontario, 12 July 1961, Forest Insect Survey No. S61-3537-01. Reared from *Pinus resinosa* Ait.; No. 9166 in the Canadian National Collection, Ottawa, Ontario. Paratypes: six ♂♂, five ♀♀, Port Burwell, Ontario, 24 June–5 August 1961, same rearing as holotype; one ♂, Bright (Lake Huron), Ontario, 24 June 1964, Forest Insect Survey No. S64-0788-01 (*Pinus resinosa*); one ♀, Elmira, Ontario, 3 August 1960, Forest Insect Survey (*Pinus resinosa*); two ♂♂, five ♀♀, Ottawa, Ontario, 12 June–6 July 1950, Forest Insect Survey No. 050-400 (*Pinus Mugho* Turra); one ♀, Ottawa, Ontario, 8 June 1951, Forest Insect Survey No. 051-349 (*Pinus Mugho*); one ♂, Harrow, Ontario, 27 June 1961, Forest Insect Survey No. S61-1206-01 (*Pinus sylvestris* L.); one ♀, Port Burwell, Ontario, 31 July 1961, Forest Insect Survey No. S61-3575-02 (*Pinus sylvestris*); one ♂, one ♀, Lake Co., Ohio, 15 June 1960, J. F. Woolton (*Pinus sylvestris*).



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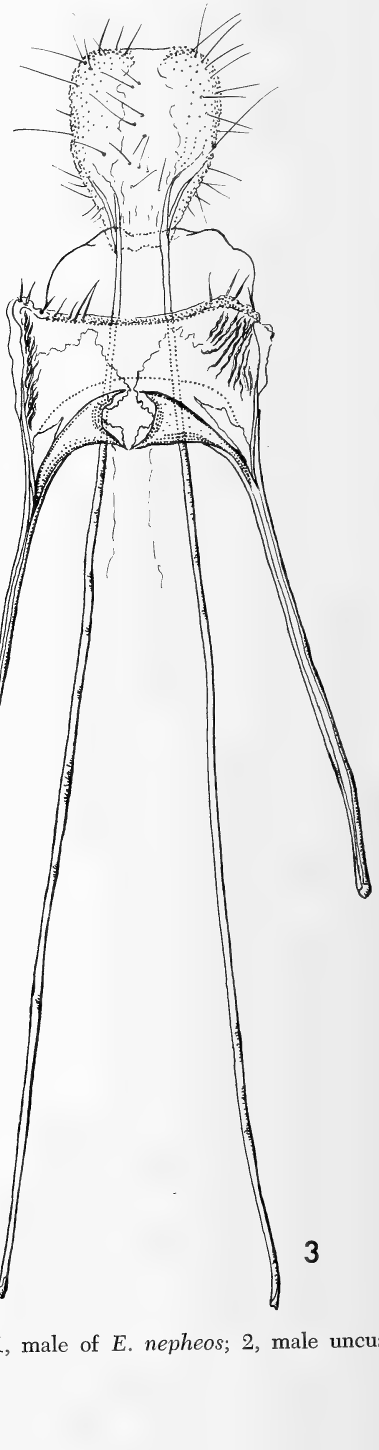

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Figs. 1–3. Genitalia of *Exoteleia* species. 1, male of *E. nepheos*; 2, male uncus of *E. pinifoliella*; 3, female of *E. nepheos*.

Flight period.—Late June to early August.

Remarks.—This species is closely allied to *E. pinifoliella* Chambers and *E. chillcotti* Freeman, but it is much darker than these two and has different genitalia. Although it was taken at the Central Experimental Farm at Ottawa in 1950 and 1951, it has not been found in the area since that time. Its presence in southernmost Ontario and directly across Lake Erie in Lake County, Ohio, suggests that it is an introduced species. However, I am unable to find an applicable name in the literature.

IDENTITY OF *CERATONYX SATANARIA*, AND THE LARVA AND PUPA OF *C. ARIZONENSIS* (GEOMETRIDAE, ENNOMINAE)

John G. Franclemont
Department of Entomology, Cornell University, Ithaca, New York

In the late summer of 1959, the larvae of a geometrid were found feeding on a small sunflower-like composite (*Viguiera multiflora* (Nutt.) Blake) in Madera Canyon, Santa Rita Mountains, Arizona. The larvae were remarkable in that each possessed a pair of stout filaments on the prothoracic segment and a single, shorter one on the eighth abdominal segment. They immediately called to mind the figure of the larva of *Ceratonyx satanaria* Guenée, 1857. I was confident that once I had the adult, I would be on the way to solving the identity of the then unrecognized Guenée species and also the position of the genus. The moths emerged during the following year, 1960, in Madera Canyon; they proved to be *Stenocharis arizonensis* Capps, 1950.

In the fall of 1961, a visit was made to Harvard University to study manuscript Abbot plates in the Houghton Library. It was from one such plate that Guenée described *Ceratonyx satanaria*. In one of the sets, that which had formerly been the property of the Boston Society of Natural History and which the Society had purchased from Dr. Oemler of Georgia, the plate numbered 157 was obviously a duplicate of the one that had served as a basis for the figure of the larva and for the description of the moth. The moth figured was without any question congeneric with the species at present placed in *Stenocharis*, in fact very similar to *S. permagnaria* Grossbeck, 1912.

During February of 1961, Mrs. William Hills of Pensacola, Florida took two specimens of a geometrid that proved to be *Ceratonyx satanaria*. Although the course of the lines does not quite match that as shown in the

Fig. 1. *Ceratonyx satanaria* Gn. Male, Escambia County, Florida; February, 1961; S. M. Hills. Expanse 38 mm.

Abbot figure, all other features of the wing pattern are essentially the same. I have examined a large number of Abbot figures of Lepidoptera, and I have found similar small discrepancies between some other figures and the moths they represent.

Lastly, *Bombycia candida* Smith, 1890, formerly placed in the genus *Euthyatiria*, is also a member of the genus being considered and is the same species as that described by Guenée. Rindge (1961) has published on the generic position of *candida*. Kimball (1965) has commented on the synonymy of *candida* and *satanaria* in his Lepidoptera of Florida, basing his remarks on information that I gave to Dr. W. T. M. Forbes in 1961.

The following synopsis gives the species known to be congeneric with *satanaria* Guenée.

CERATONYX Guenée

Ceratonyx Guenée, 1857, Histoire Naturelle des Insectes, Species Général des Lépidoptères, 9 (Uranides et Phalénites, vol. 1): 193.

Type: *Ceratonyx satanaria* Guenée, 1857. Present designation. Guenée included two species, *satanaria* and *carmelitaria*, another new species, designated by Guenée as *Ceratophora carmelitaria* on plate 3, figure 6.)

Stenocharis Grossbeck, 1912, Bull. Amer. Mus. Nat. Hist., 31: 399. (NEW SYNONYMY)

Type: *Stenocharis permagnaria* Grossbeck, 1912. Monotypy.

Ceratonyx satanaria Guenée
Figure 1

Ceratonyx satanaria Guenée, 1857, Histoire Naturelle des Insectes, Species Général des Lépidoptères, vol. 9 (Uranides et Phalénites, vol. 1): 194, pl. 2, fig. 2 (larva); Kimball, 1965, Lepid. Florida, Anthrop. Fla., 1: 184, pl. 22 (Synonymy).
Type locality: "Géorgie americaine, en fevrier."
Location of type: Unknown; described from an Abbot drawing.
Bombycia candida Smith, 1890, Ent. Americana, 6: 179.
Stenocharis candida (Smith); Rindge, 1961, Amer. Mus. Novit., No. 2065, p. 10.
Euthyatira candida; Kimball, 1965, Lepid. Florida, Arthrop. Fla., 1: 160.
Type locality: "Florida."
Location of type: American Museum of Natural History, New York.

Ceratonyx permagnaria (Grossbeck), new combination

Stenocharis permagnaria Grossbeck, 1912, Bull. Amer. Mus. Nat. Hist., 31: 400.
Type locality: "Chiricahua Mts., Cochise Co., Arizona."
Location of type: United States National Museum.

Ceratonyx arizonensis (Capps), new combination

Stenocharis arizonensis Capps, 1950, Bull. So. California Acad. Sci., 49: 12, pl. 4, fig. 1–4.
Type locality: "Hereford, Arizona."
Location of type: United States National Museum.

Ceratonyx cornifrons (Dyar), new combination

Coenocharis cornifrons Dyar, 1914, Proc. U. S. Natl. Mus., 47: 390.
Stenocharis cornifrons; Capps, 1950, Bull. So. California Acad. Sci., 49: 12.
Type locality: "Sierra de Guerrero, Mexico."
Location of type: United States National Museum.

Ceratonyx hoplitaria (Dyar), new combination

Coenocharis hoplitaria Dyar, 1912, Proc. U. S. Natl. Mus., 42: 92.
Stenocharis hoplitaria; Capps, 1950, Bull. So. California Acad. Sci., 49: 12.
Type locality: "Tehuacan, Mexico."
Location of type: United States National Museum.

Ceratonyx rhadinaria (Dyar), new combination

Caenocharis [*sic*] *rhadinaria* Dyar, 1916, Proc. U. S. Natl. Mus., 51: 30.
Stenocharis rhadinaria; Capps, 1950, Bull. So. California Acad. Sci., 49: 12.
Type locality: "Cuernavaca, Mexico."
Location of type: United States National Museum.

Early stages of Ceratonyx arizonensis

Last instar larva (Fig. 2).—Body moderate in build (of about average thickness for a geometrid of its length), approximately forty mm long when full-grown and at rest. Anterior, lateral margins of prothorax with a pair of long (10 mm), stout, horn-like filaments. Eighth abdominal segment with a short (3 mm), stout, median horn-like filament. Integument filaments included, densely covered with fine spicules. Pinacula of setae somewhat raised. Crochet rows of prolegs not

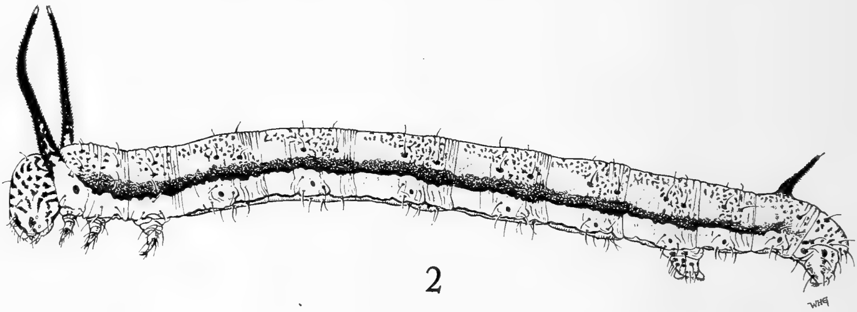

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Fig. 2. *Ceratonyx arizonensis* Capps. Larva. Madera Canyon 7200′, Santa Rita Mountains, Santa Cruz County, Arizona; September 1959.

interrupted. Head gray-white with a pattern of black dots in groups suggesting irregular lines. Prothoracic filaments black with some irregular white spotting near bases, tips white and contrasting; filament of eighth abdominal segment black. Dorsum of all segments grayish white with an irregular, open, reticulate pattern of black; 11 crimson subdorsal blotches, first and last small, remainder covering posterior and anterior parts of preceding and succeeding segments; a broad, black subdorsal line; a very broad, yellow stigmatal band; a narrow, black substigmatal line; venter grayish white with a slight pattern of irregular black dots near substigmatal line. Spiracles circular, black. Proleg of sixth segment grayish white, the pinacula of setae black.

Pupa: Heavily sclerotized, rugose and deeply pitted. Cremaster of two stout, curved hooks; dorsal groove present and deep, its posterior margin deeply and irregularly incised; lateral groove well formed, broad with a high, raised posterior margin; fifth segment without noticeable modifications; fifth, sixth, and seventh segments with marked, raised anterior ridges, most strongly developed ventrally; the sixth segment with two strong ventral callosities.

Five larvae collected (one preserved, four reared to adults); Madera Canyon, Santa Rita Mountains, Santa Cruz County, Arizona; two at 4,880 feet elevation and three at 7,200 feet elevation; in late September feeding on leaves of *Vigueria multiflora* (Nutt.) Blake.

I wish to express my thanks to Dr. W. H. Bond of the Houghton Library at Harvard University for the assistance and courtesy shown me during my use of the library.

The drawing of the larva of *C. arizonensis* was made by Mr. William H. Gotwald, graduate student in the Department of Entomology, Cornell University.

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Rindge, F. H., 1961. Descriptions of and notes on North American Geometridae (Lepidoptera), No. 5. Amer. Mus. Novitates, 2065, 11 pp.

THE BIOLOGY AND DESCRIPTION OF IMMATURE STAGES OF *EXOTELEIA NEPHEOS* (GELECHIIDAE) ON PINE IN ONTARIO

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Introduction

Adults of an undescribed species of *Exoteleia*, were first obtained by the Forest Insect and Disease Survey in 1958 during rearing experiments with the European pine shoot moth, *Rhyacionia buoliana* (Schiffermüller). Larvae and pupae of the *Exoteleia* were not found in the field until 1961, and in the following year a life history study was begun near Port Burwell in southern Ontario where relatively pure populations were detected on red and Scots pine. Most of the observations and stages described in this paper pertain to material collected on red pine because of the larger numbers of *Exoteleia* present on that host in the study area. Freeman (1966) described the adult as *Exoteleia nepheos*.

Distribution, hosts, and injury

E. nepheos is known in southwestern Ontario at Harrow, Port Burwell, Woodstock, Elmira, and Alliston. The insect has also been reported from Toronto, Ottawa, and Ohio (Freeman, 1966).

E. nepheos has been found on red pine, *Pinus resinosa* Aiton, less frequently on Scots pine, *P. sylvestris* Linnaeus, and rarely on Mugho pine, *P. mugho* Turra. The Port Burwell infestations have persisted at least since 1961 when they were discovered on trees 10 to 25 feet in height.

Larval feeding of *E. nepheos* stunts growth of the new shoots (Fig. 4) giving the branches of infected pines a tufted appearance. However, trees attacked for at least three successive years in the study area do not appear to have been damaged seriously and the insect is currently of little consequence in pine plantations of southern Ontario.

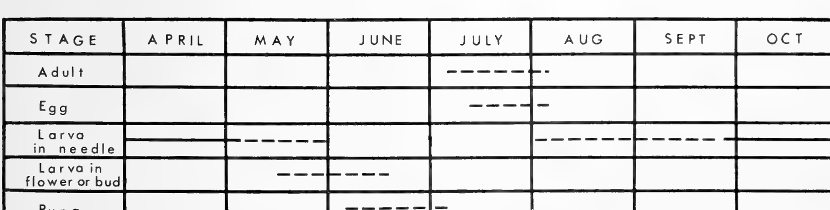

Fig. 1. Seasonal distribution of the stages of *Exoteleia nepheos* Freeman.

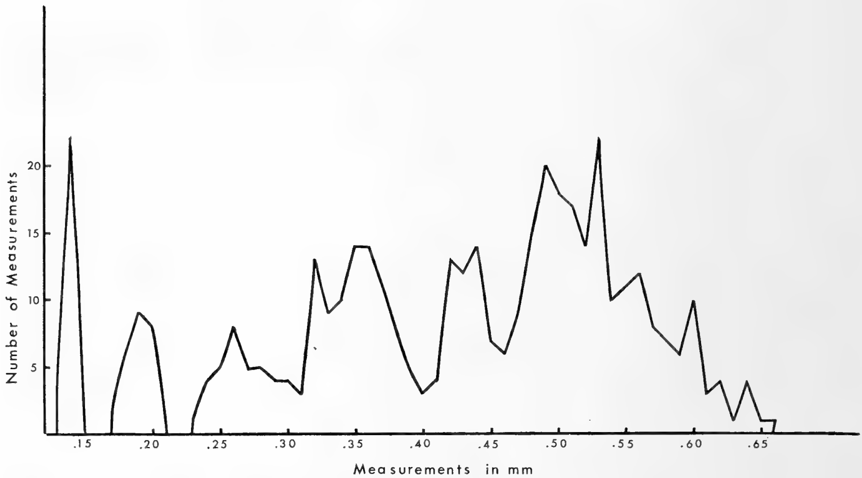

Fig. 2. Distribution of larval head capsule measurements for *Exoteleia nepheos* Freeman.

Life history and habits

E. nepheos has one generation a year in Ontario. The course of seasonal development is shown in Fig. 1.

There are probably five larval instars, although the distribution of 428 head capsule measurements as shown in Fig. 2 indicates a possible anomaly among head capsules measuring 0.40 to 0.46 mm. The theory of geometric progression of head capsule widths proposed by Dyar (1890) supports five larval instars. Mean widths for instars I and II, 0.136 and 0.190 mm respectively, were used to calculate the following theoretical widths of successive instars: Instar III, 0.26 mm, Instar IV, 0.355 mm, and Instar V, 0.485 mm. As may be seen in Fig. 2, these values closely approximate the midpoints of the distributional curves for the last three of five instars. Martin (1959) mentions that the related species, *Exoteleia dodecella* (Linnaeus) has five larval instars.

Adult flight occurs from early July to early August, with moth activity around host trees restricted to late evening from about 2200 hours to midnight E.D.S.T. Mating was not observed. The greatest number of adults appeared on warm nights when a light breeze was blowing; few

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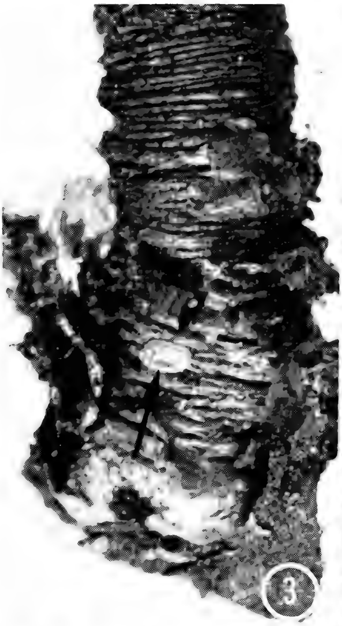
Figs. 3–6. *Pinus resinosa* affected by early stages of *Exoteleia nepheos* Freeman; 3, needle sheath with egg; 4, shoots affected by larvae (right) and unaffected (left); 5, shoot stunted by larval feeding; 6, infested staminate flowers tied with silk. Photos by D. C. Anderson.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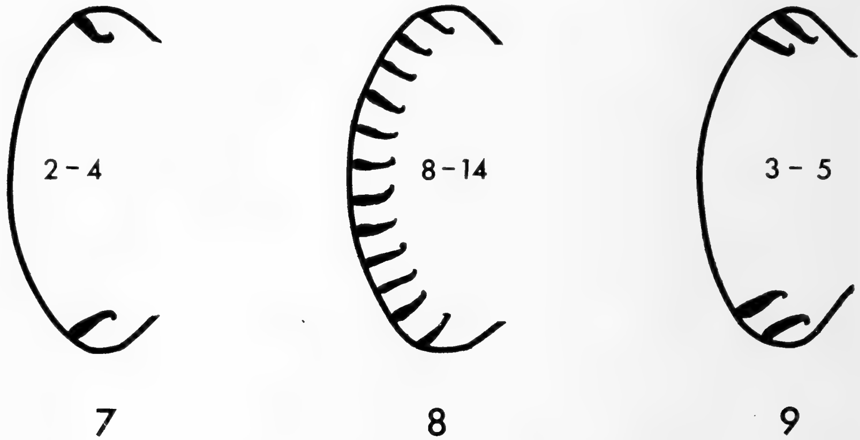

Figs. 7–9. Diagrammatic representation of crotchets of *Exoteleia* species; 7, *E. nepheos* Freeman; 8, *E. dodecella* (Linnaeus); 9, *E. pinifoliella* (Chambers).

were present on cool, calm nights, or if dew was forming on the foliage. When seen with the aid of a flashlight, moths were extremely active, walking rapidly along needles and twigs, with antennae vibrating. During oviposition, which lasts from 20 to 60 seconds, the abdomen is arched and the antennae are motionless.

Eggs (Fig. 3) are usually laid singly, rarely in clusters of two to four, on needle sheaths of the previous year's foliage or occasionally under loose bark scales of twigs. When laid on the needle sheath, eggs are usually concealed under the membranous scales near the base, but occasionally they are found between transverse folds or fully exposed on the sheath surface.

First instar larvae are found in early August, mining along the edges of the apical portion of needles. The entrance hole to the mine is covered with silk and usually occurs on the flat side of the needle. By early September most of the larvae are in the second instar. Third instar larvae are present in early October, and by mid-November most larvae are in the fourth instar, overwintering in the needle mine. In spring, they vacate this mine and enter the same needle at a lower point or an adjacent needle. Mining appears to be restricted to the apical two-thirds of each needle with emergence and exit holes varying considerably both in number and location on the needle. Mining terminates in mid- to late May, when the larvae migrate and feed in staminate flowers or elongating buds (Figs. 5, 6).

Fig. 10. Female pupa of *Exoteleia nepheos* Freeman, ventral aspect; abdominal segments 5–10 indicated.

In mid-June, pupation occurs in the flowers and shoots honeycombed by the feeding larvae, and moths emerge in about two weeks. Because of silk spun by the larvae, flower clusters are not shed but often remain on the tree throughout the summer.

Description of immature stages

Egg (Fig. 3).—About 0.5 mm long, 0.3 mm wide, more or less cylindrical with rounded ends; patterned with fine granulations, silvery-white, and becomes yellowish as the émbryo develops.

Larva.—Pale yellow brown, at first, later in initial instar, body reddish, anal shield grey. Sclerotized areas gradually darken in succeeding instars. Overwintering larva, with head and sclerites on thoracic legs dark brown, prothoracic and anal shield slightly lighter; body reddish-brown. Mature larva about 6.5 mm in length, body pale yellow with a reddish hue. Spinules greyish, readily discernible, particularly on posterior segments at 25× magnification. Pinacula on posterior segments relatively large, darker than integument. Head, prothoracic shield, and sclerites on prothoracic legs brown-black. Anal shield and lateral sclerites on anal prolegs yellow to dark brown. Anal comb absent. Abdominal prolegs each bearing 5 to 10 crotchets which tend to form a circle. Each anal proleg usually bears a single crochet, occasionally two, near each lateral margin (Fig. 7). Subventral (SV) setae on abdominal segments 1, 2, 7, and 8 usually number 2 : 3 : 2 : 1. Setal map of some body segments in Fig. 11.

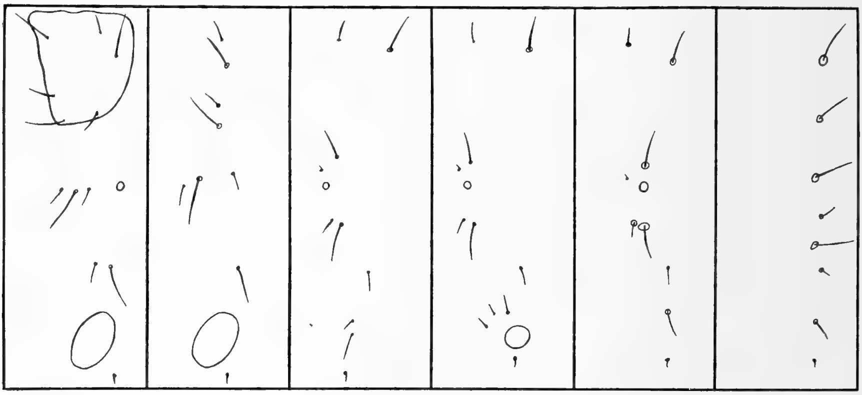

Fig. 11. Diagrammatic setal map for larva of *Exoteleia nepheos* Freeman; thoracic segments 1 and 2, abdominal segments 1, 3, 8, and 9.

Pupa (Fig. 10).—Yellowish brown, flattened dorsoventrally, averaging 3.9 mm in length and 1.2 mm in width. Antennae and wings extend to anterior edge of abdominal segment 6. Proleg scars present ventrally on abdominal segment 6. Spiracles relatively conspicuous, laterally on abdominal segments, setae short and fine. Abdominal segments 8 to 10 fused with fine hooks arranged around the combined segments.

PARASITES

Three chalcid parasites, identified at the Entomology Research Institute, Ottawa, were reared from material collected at Port Burwell. *Achrysocharis* sp. (Eulophidae) and *Copidosoma geniculatum* (Dalman) (Encyrtidae) issued from host larvae, and *Eurytoma* sp. (Eurytomidae) from host pupae.

COMPARISON WITH OTHER SPECIES OF *EXOTELEIA* ON PINE

Three species of *Exoteleia* are known to occur in Ontario, *nepheos* Freeman, *dodecella* (L.), and *pinifoliella* (Chambers). They maye be separated by differences noted in Table I and keys to larvae and pupae.

TABLE I—COMPARISON OF BIOLOGICAL FEATURES OF THREE SPECIES OF *EXOTELEIA* IN ONTARIO

	nepheos	*dodecella*	*pinifoliella*
Host Preference	red pine, Scots pine	Scots pine, Mugho pine	jack pine
Pupation Site	flowers, buds	buds	needle mine
Adult Flight	July	mid-June to early July	late June to mid-July

Key to larvae of *Exoteleia* species in Ontario

1. Crotchets on anal proleg in a single uninterrupted series of 8–14 (Fig. 8) .... *dodecella*
   Crotchets on anal proleg in two series of 1–3 situated near each lateral edge of proleg (Figs. 7, 9) 2
2. SV setae on abdominal segments 1, 2, 7, and 8 usually numbering 2 : 3 : 2 : 1 (Fig. 11); anal proleg usually with a single crotchet near each lateral margin (Fig. 7). .... *nepheos*
   SV setae on abdominal segments 1, 2, 7, and 8 usually numbering 1 : 2 : 1 : 1 (Lindquist, 1963); anal proleg with usually a pair of crotchets near each lateral margin (Fig. 9). .... *pinifoliella*

Key to pupae of *Exoteleia* species in Ontario

The pupae of *nepheos* and *dodecella* are not readily separable, except by colour, although they are distinct from *pinifoliella*. The following key attempts to separate the three species:

1. Pupa near black, in the needle mine; cutting plate present on frontal area of head (Bennett, 1954) .... *pinifoliella*
   Pupa yellow-brown or red-brown, in buds or flowers; cutting plate absent 2
2. Dark red-brown pupa; anal end tending to be notched (Martin, 1959) .. *dodecella*
   Yellow-brown pupa; anal end not notched (Fig. 10) .... *nepheos*

Acknowledgments

We wish to thank Mrs. Zena Faux for her assistance in the preparation of the figures, and Mr. George Cruikshank of the Ontario Department of Lands and Forests, St. Williams, Ontario for providing a winter collection of study material.

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Book Notice

LEPIDOPTERA OF AMERICAN SAMOA, with particular reference to biology and ecology, by John Adams Comstock. To be published by the Bernice P. Bishop Museum, Honolulu, Hawaii, December, 1966; about 75 pp. Price $3.50 bound, $2.50 paper covers.

An annotated list of 118 species of Lepidoptera from American Samoa. Descriptions are given of immature stages of many of the species. There are 13 plates, with colored paintings of immature stages, and black and white photographs of adults.—J. Linsley Gressitt, *Bishop Museum, Honolulu, 17, Hawaii.*

THE LIFE HISTORY OF *SCHINIA FELICITATA* (NOCTUIDAE)

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Entomology Research Institute, Canada Dept. Agric., Ottawa, Ontario, Canada

Schinia felicitata (Smith)[1] feeds in the larval stage on the buds, blossoms and seed capsules of *Oenothera deltoides* Torr. The little heliothidine moth was described by Smith from southwestern Utah, and was subsequently redescribed by Barnes and McDunnough (1911) from the Imperial Valley of California as *Chlorocleptria imperialis*. It was from near the latter locality, in the Indio area of southern California, that material was obtained for developmental studies in the spring of 1955.

S. felicitata is distributed from the Colorado Desert of southern California, northward to Inyo County, California, and eastward to Phoenix, Arizona. It is in flight between the first of March and the middle of April. During 1955 the species proved to be common in those areas of southern California in which its food plant was abundant and in blossom.

The forewing of some specimens of *felicitata* is suffused with pink, and this color phase bears a close resemblance to the eastern and central North American *Schinia florida* (Guenée)[2], which feeds in the larval stage on *Oenothera biennis* L. Although *felicitata* is smaller and darker than *florida*, the similarity between the two species, noted by Smith in his original description of *felicitata*, is often striking. The reason for the development and maintenance of the pink suffusion is probably the same in both species: the coloring of the forewings in their resemblance to the pink dying petals of both food plants probably affords the adults considerable protection from predators when the moths are resting among the buds and blossoms at the apex of the plant during the daylight hours.

BEHAVIOR

Although at least some adults of *felicitata* are protectively colored in their resemblance to dying petals and others bear at least a casual resemblance to the buds and seed pods, the habit of resting at the apex of the food plant is evidently much less highly developed than it is in many species of *Schinia*. Although the first female from which eggs were obtained was taken in the early morning from a still-open blossom of *O. deltoides*, a subsequent search of several hours duration yielded only a single male nestled among leaves and buds. At the time of this search,

[1] *Alaria felicitata* Smith, 1894, Trans. Amer. ent. Soc., 21: 86. *Schinia felicitata*, Hardwick, 1958, Canad. Ent., Suppl. 6: 14.

[2] *Rhodophora florida* Guenée, 1852, Hist. Nat. Ins. Lep., 6: 171. *Schinia florida*, Hardwick, 1958, Canad. Ent., Suppl. 6: 10.

numerous adults were being taken in light traps, and eggs could be found in abundance at the apex of the food plant.

The females are apparently similarly unspecialized in depositing their eggs. The eggs are scattered on the buds, blossoms and apical leaves of the plant (Fig. 2). Captive females confined with buds of the food plant frequently oviposited on the floor of the container and occasionally inserted their ovipositors through the mesh lid of the cage and deposited their eggs on the wire screening.

Five wild-caught females deposited a mean of 116 eggs, and the maximum deposited by one was 161. The majority of eggs hatched on the fifth day after deposition, a few on the sixth day. All larvae that were individually reared completed their development in five stadia.

The newly hatched larva wanders about the apex of the plant for some time before boring into the side of a flower bud. Usually the bud is perforated near the base. Not infrequently the young larva bores into the pedicel and tunnels through it up into the bud, within which it feeds on the sexual parts of the plant. During the third or fourth stadia, the larva quits the first bud and tunnels into a second. In the fourth stadium, the larva commonly ceases to secrete itself within an individual bud and feeds on the contents from a position on the outside. Fourth and fifth stadium larvae often feed on the seed capsules, but even in these later instars, the buds are the most commonly attacked parts of the plant. The mature larva enters the ground to pupate.

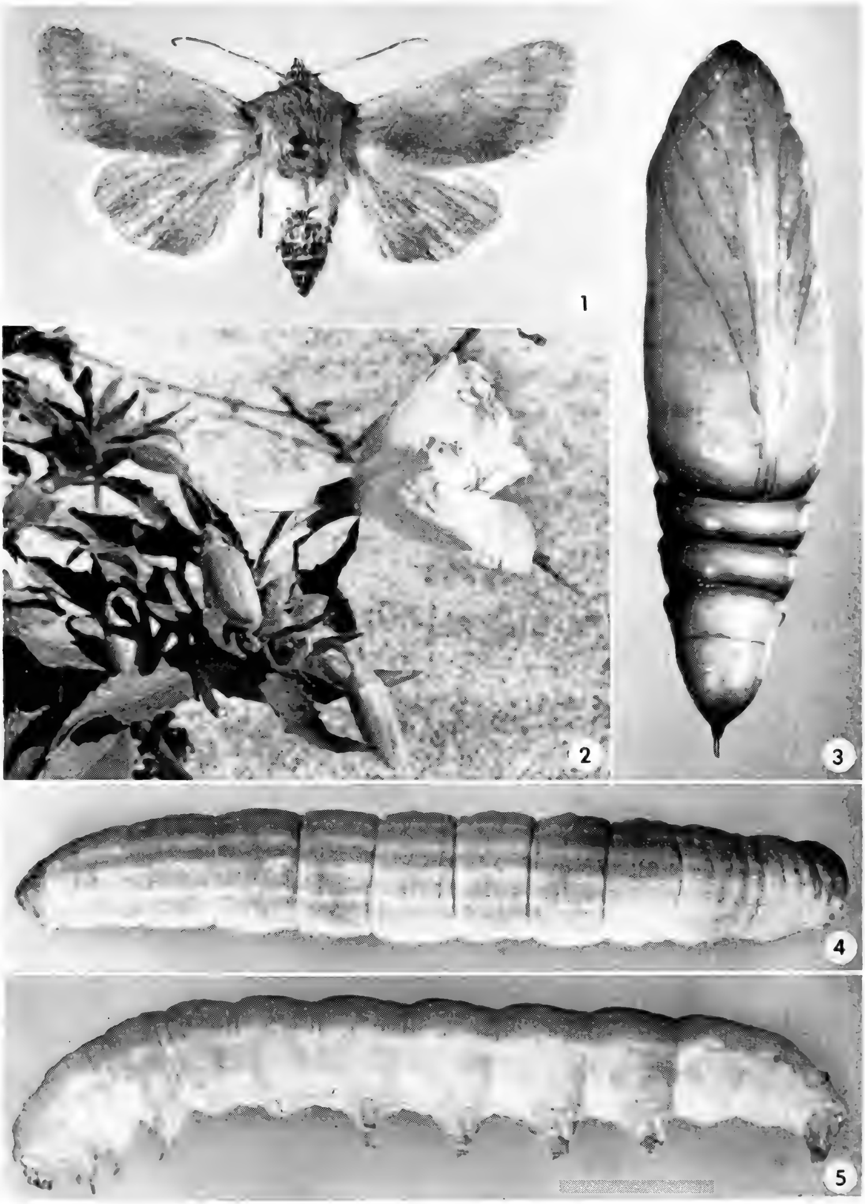
Rearing techniques employed in obtaining larvae for descriptions were those outlined by Hardwick (1958).

Descriptions of stages

Adult (Fig. 1). Head and thorax pale fawn, occasionally suffused with pink. Abdomen pale fawn-gray to silvery gray. *Forewing upperside*, pale creamy fawn to medium fawn, variably suffused with pink in basal, median and subterminal spaces. Forewing usually almost immaculate. Transverse anterior line absent. Transverse posterior line often vaguely indicated by a darkening of the ground color between median and subterminal spaces. Subterminal line usually undefined; in specimens suffused with pink, however, s.t. line often well defined by color change between pink of subterminal space and fawn of terminal space. Orbicular spot absent. Reniform spot often indicated as a darker shade. Fringe concolorous with terminal area of wing. *Hindwing upperside*, occasionally gray with smoky brown outer-marginal band and discal spot; in most specimens, however, hindwing so heavily suffused with smoky brown as to practically obliterate darker markings. Fringe pale gray. *Underside*, pale fawn-gray along costal, outer and inner margins. Central triangle of wing grayish brown to light chocolate-brown. Reniform usually indicated as a darker brown spot. Hindwing uniform pale fawn-gray. Fringes of both wings concolorous with wings. In specimens suffused with pink on upperside, often much pink scaling along costal margins of both wings on underside.

Expanse: 27:7 ± 1.4 mm[3] (100 specimens).

[3] Standard deviation.



Figs. 1–5. *Schinia felicitata* (Smith), La Quinta, Riverside Co., Calif. 1, Adult. 2, Eggs on buds and apical leaves of *Oenothera deltoides* Torr. 3, Ventral aspect of pupa. 4, Dorsal aspect of larva. 5, Left lateral aspect of larva.

EGG. Pale creamy white when deposited, remaining unchanged for one day. A pink flush becoming evident at micropylar end on second day. Entire micropylar half of egg darkening to reddish brown on third day; the two hemispheres sharply defined. Little change during fourth day except posterior half of egg becoming yellowish fawn. On fifth day reddish coloring of micropylar half fading and larva becoming visible through chorion.

Dimensions of egg: length, 0.72 ± 0.05 mm; width, 0.66 ± 0.07 mm (20 eggs).

FIRST STADIUM LARVA. Head very dark brown or black. Prothoracic shield dark brown. Suranal shield medium grayish brown. Trunk creamy white to pale gray. Rims of spiracles, setal bases, and thoracic legs medium grayish brown.

Head width: 0.33 ± 0.02 mm (20 larvae).

Duration of stadium (at room temperature): 4.0 ± 1.5 days (54 larvae).

SECOND STADIUM LARVA. Head medium brown to dark blackish brown. Prothoracic and suranal shields somewhat paler brown then head capsule. Trunk creamy white or pallid gray; occasionally a pair of paler lines evident on dorsum. Setal bases grayish brown. Rims of spiracles and thoracic legs dark grayish brown.

Head width: 0.55 ± 0.03 mm (20 larvae).

Duration of stadium: 3.0 ± 1.1 days (54 larvae).

THIRD STADIUM LARVA. Head fawn, variably mottled with medium brown, often heavily, largely obscuring fawn. Prothoracic and suranal shields grayish fawn or greenish fawn, variably, usually lightly marked with medium brown; prothoracic shield most heavily marked along lateral and posterior margins. Middorsal band green, grayish green, or yellowish green. Subdorsal area with yellow marginal lines and a median band of somewhat paler green than middorsal band. Supraspiracular area broad, concolorous with median band of subdorsal area. Spiracular band narrow, yellow, not sharply defined. Spiracles with medium brown rims. Ventral region essentially concolorous with green of dorsal area, occasionally of a grayer shade. Setal bases grayish fawn. Thoracic legs grayish fawn, variably suffused with medium brown.

Head width: 0.85 ± 0.04 mm (20 larvae).

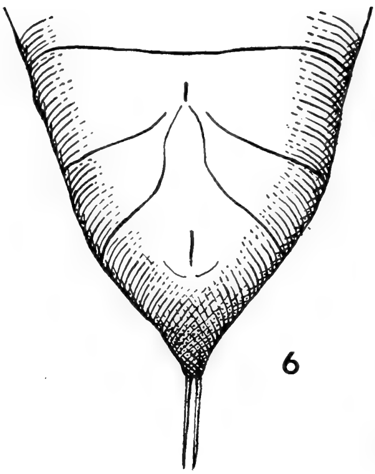
Duration of stadium: 3.1 ± 1.1 days (54 larvae).

FOURTH STADIUM LARVA. Head pale creamy white, mottled dorsally with pale fawn. Prothoracic and suranal shields cream to greenish yellow. Trunk medium green to light greenish yellow. Dorsal area of paler specimens often suffused with pale pink or mauve. Middorsal band usually somewhat darker than remainder of trunk. Subdorsal area with a broad, green median band and narrower marginal bands of pale yellow or cream. Supraspiracular area concolorous with median band of subdorsal area. Spiracular band pale yellow or cream. Spiracles with light brown rims. Suprapodal area concolorous with supraspiracular area. Midventral area grayish green. Immediate apexes of setal bases medium brown, remaining portions concolorous with ground color. Thoracic legs cream to very pale fawn, often suffused with light green.

Head width: 1.4 ± 0.6 mm (20 larvae).

Duration of stadium: 2.6 ± 0.8 days (54 larvae).

FIFTH STADIUM LARVA (Figs. 4, 5). Head cream, fawn or fawn-gray, often with slightly darker fawn mottling. Prothoracic and suranal shields not distinguished from trunk except by absence of longitudinal lines. Trunk beautiful pastel shades of pink, mauve or green. Maculation not sharply defined. Middorsal band narrow. Subdorsal area with narrow marginal bands of pale yellow or cream, and a broader median band concolorous with, or only slightly paler than, middorsal band. Supraspiracular area concolorous with median band of subdorsal area. Spiracular band cream or pale yellow. Spiracles with light brown rims. Suprapodal area concolorous with supraspiracular area. Midventral area greenish gray in green specimens, fawn-gray in pink and mauve specimens. Setal bases concolorous with trunk. Thoracic legs pale cream, tinged with green or pink.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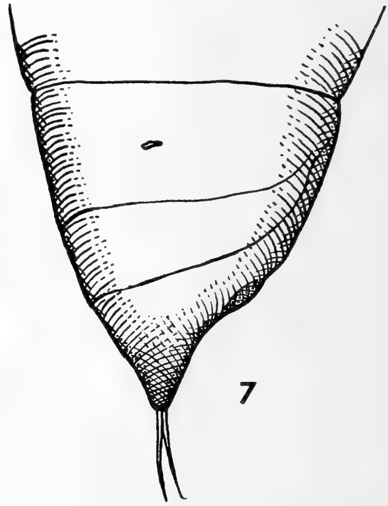
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Figs. 6, 7. *Schinia felicitata* (Smith), apical abdominal segments of pupa. 6, Ventral. 7, Right lateral.

Head width: 2.10 ± 0.09 mm (20 larvae).

Duration of stadium: 4.1 ± 1.1 days (54 larvae).

PUPA (Fig. 3). Orange-brown. Spiracles essentially level with general surface of cuticle or only weakly projecting above it. Anterior areas of abdominal segments 5, 6 and 7, moderately pitted. Apex of proboscis usually extending slightly beyond apices of forewings. Cremaster (Figs. 6, 7) usually consisting of two elongate, slender, straight or weakly curved spines borne at the apex of a conical prolongation of the tenth abdominal segment. In one of twenty pupae examined, however, a pair of short spines flanking median pair.

Length to posterior margin of fourth abdominal segment: 11.7 ± 0.5 mm (20 pupae).

ACKNOWLEDGMENT

I am grateful to Mr. John E. H. Martin, Entomology Research Institute, Ottawa, for assistance in the field and for photographing larvae and food plants.

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EARLY STAGES OF SPHINX SEQUOIAE ENGELHARDTI (SPHINGIDAE)

John Adams Comstock and Christopher Henne
Del Mar, California and Pearblossom, California

A distinctive type of larva with highly adapted maculation was found resting upon an upper branch of a large *Juniperus californica* bush at Red Rover Mine Canyon, northwest of Acton, Sierra Pelona Valley, Los Angeles County, Calif., July 20 1962, El. 3,150'. An adult female Sphinx moth emerged on August 13 of the same year and was first erroneously designated by Henne prior to the correct determination of our west coast reference collection series, as *Sphinx dolli australis.* It was so reported in the season's summary of the Lepidopterists' News, 1963, 4. p. 2, and as *Sphinx dolli* in Lep. News, 3. p. 4, 1965. Both statements will be rectified in a subsequent issue of the Lep. News.

B. P. Clark, (1919), described S. *engelhardti* as a subspecies of *Sphinx dolli*, but a year later, (1920) corrected the specific assignment and recorded it as *Sphinx sequoiae engelhardti.*

Brief notes were made of this first larva just prior to its entering the soil of a rearing cage for pupation, the night after it had been collected. It was considered inadvisable to publish these notes until a more complete study had been made of the early stages of this subspecies, and illustrations could be included. An opportunity did not arise for this until the summer of 1965, when two gravid females were collected (at 15 w. black light) at Juniper Hills, Mojave Desert, L. A. County, Calif., on July 29, and July 31. Fertile eggs were laid by both moths August 2, on fresh *Juniperus* placed in a jar of water, and covered by a large brown paper bag. These eggs hatched August 14, 1965.

One problem in determination gave us some difficulty. Williams (1905) writing on the larva of *Sphinx sequoiae*, stated that the pupa had "no protruding tongue case," and that the larva fed on *Cerasus,* [properly now designated *Prunus virginiana* var. *demissa* (Nutt.) Sarg.] (western choke cherry). He repeated that statement in 1909. We felt this must have been an error in larval identification, and Dr. Williams confirmed our suspicion, kindly calling our attention to a paper (1958) wherein he corrected the error. In this he stated that what he probably described "were the early stages of *Smerinthus jamaicensis* Drury," and that "the pupa . . . did not hatch." His closing paragraph read "As far as I am aware, the early stages of *Sphinx sequoiae* are still unknown, but its caterpillar may well feed upon one of the coniferous trees."

GEOGRAPHICAL DISTRIBUTION

The four specimens which constituted the type series of *Sphinx sequoiae engelhardti* were collected at Bellevue, Washington County, Utah, by Jacob Doll and George Engelhardt in 1917. Two examples were recently taken by Fred Truxal in Baja California, locality not stated. Rick Westcott reported collecting one at Jacumba, San Diego County. The California Insect Survey has specimens taken by Jerry A. Powell at Scissors Crossing, 6 miles E. of Banner, San Diego County, July 13, 1963 (det. C. D. MacNeill). Our series are all from the Mojave Desert of California and Sierra Pelona Valley, L. A. County, as are also those in the Los Angeles County Museum collection.

Lloyd Martin of the L. A. Museum staff is of the opinion that the species "follows the juniper belt from the Great Basin into margins of Mojave and Colorado Deserts." Probably it will be found through the entire ranges of *Juniperus californica* Carr, and *J. osteosperma* (Torr.) Little.

A detailed description of the early stages follows:

EGG: (Figs. 1 and 2) Length, 2.33 mm. Width, 1.8 mm. Form oval. Surface texture appearing, superficially, smooth, lustrous, on high magnification seen to be covered with shallow ovoid cells, all in close contact. Glistening green.

LARVA, *First instar*: (Figs. 3 and 4) Length, 5 mm. Head width, 1.2 mm to 1.4 mm. Head, uniform orange-yellow. Ocelli black tipped. Mandibles dark.

Body tapering from first segment to narrower cauda. Ground color light yellow-green. First thoracic segment with a raised, black anterior margin along its upper half. A pair of raised black knobs on this dark margin, one on each side of middorsal space. A semilunar prothoracic raised shield, dull green in color. Longitudinal lines of raised black dots along the length of the body, most or all of which bear minute black setae.

Caudal horn on the 11th segment rising superiorly, then arches anteriorly; height 3 mm, width 0.3 mm; topped by two minute spurs. In some examples the horn erect.

Body dull orange-gray, heavily incrusted with minute black nodules. Thoracic legs, black, proximal segments yellow. Prolegs, yellow.

Second instar: Length, 9 mm. Width across 5th segment approximately 2 mm. Head width, approximately 1.8 mm. Head green, slightly more yellowish than the color of juniper twigs. Mandibles tinged with brown.

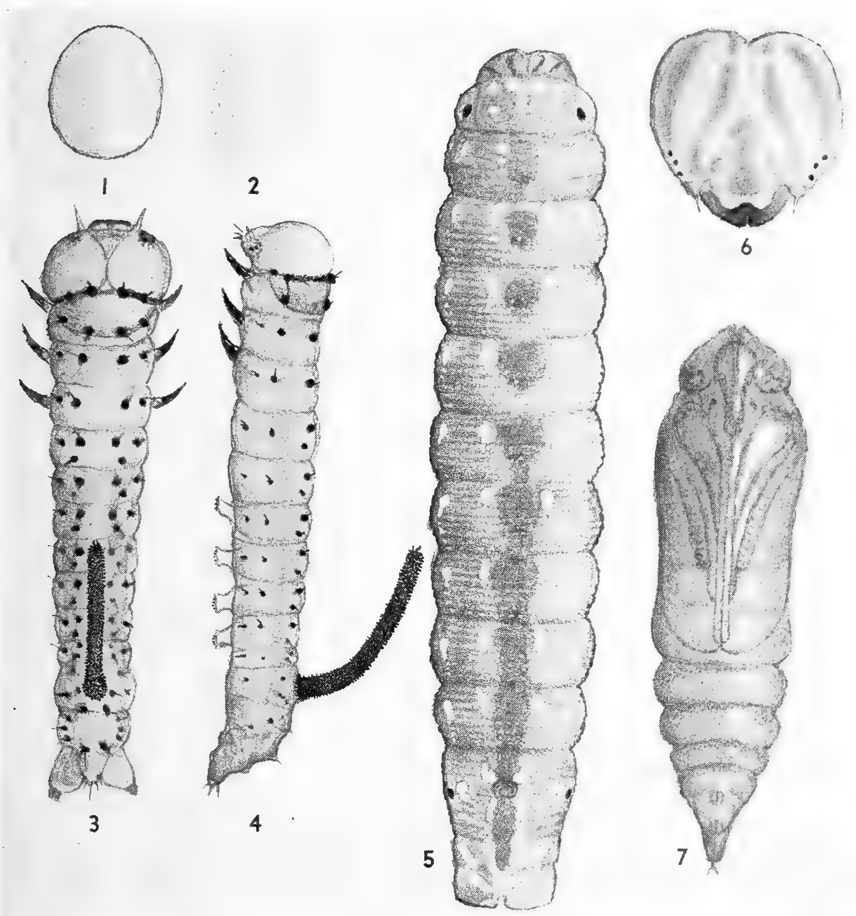
Body, uniform green, exactly matching juniper foliage. First segment with same ridges and nodules as in first instar, but yellow. Caudal horn, dull yellow, with a black bifurcated tip; held constantly at right angles to body; surface roughened by minute spicules; base tinged with orange; height, 3.3 mm.

Thoracic legs, green, with black terminal segments. Prolegs concolorous with body. Crochets light brown.

Third instar: Length, just prior to moult, 15 mm. Width, in mesothoracic segment, 3 mm.

Head, uniform green, covered with minute punctations. Mandibles, dark brown. Head width, 2.1 mm.

Body surface minutely rugose and glistening. Shallow transverse creases between segmental junctures. Ground color greenish-yellow to greenish-white, with green blotches dorsally and subdorsally, partially obscuring ground color, giving a scaled appearance, somewhat resembling juniper leaves. Dorsal and sublateral green



Explanation of Plate

Sphinx sequoiae engelhardti Clark. Fig. 1, Egg. Fig. 2, Highly magnified surface of egg. Figs. 3 and 4, First instar larva, dorsal and lateral aspects. Fig. 5, Mature larva, dorsal aspect. Fig. 6, Frontal view of head, enlarged. Fig. 7, Pupa, ventral aspect.

Reproduced from water color drawing by J. A. Comstock.

blotches slightly tinged with pinkish-tan internally. The dark spiracles contained within large semicircles of greenish-yellow merging with infrastigmatal fold. Caudal horn yellowish-green, slender and long, originating from a brownish hump, rising vertically, 3 mm in height, to a dark brown forked and recurved tip. Minute, stiff, erect, brown spines throughout its length.

A fine dark pile covering dorsal surface of body, observable under an 8 × lens. Ventral surface more uniform in surface pattern than remainder of body, concolorous with it.

Thoracic legs, dark brown. Prolegs, translucent green.

Fourth instar: Length, 30 mm, width through widest segment, 3 mm.

Head width, 3 mm; mottled yellowish-green and darker green; covered with minute setae arising from small nodules, such as occur over body surface. Mandibles and antennae dark brown.

Body ground color, glistening bright green with a yellowish cast. Under 8 × magnification body seen to be covered with minute yellow nodules bearing colorless setae. Fine transverse creases on posterior portion of each segment terminating laterally at infrastigmatal fold. Four rows of pure white spots in the form of droplets subdorsally and laterally (about 9 per row); interspaced by finely traced white lines. Six transverse, somewhat triangular, red-brown markings middorsally shading to slightly darker at perimeters. These beginning segment 5 between the white spots, continuing to caudal hump. Latter superimposed by a rugose, rather bulbous, fleshy-appearing excurved horn, tipped by a pair of short, dark brown, tooth-like processes.

The black spiracles encircled by a dense, light tan pile with a frosted appearance under a lense; becoming lighter and less dense, tending to terminate sublaterally. At the lower broken line of white spots, a slight covering of pile continuing down to upper portion of each proleg.

Cervical shield dorsally with four yellowish, transverse dashes on anterior edge, four centrally located radiating whitish dashes.

Frontal spiracle diagonally placed, larger, more intensely marked than the others, with a conspicuous red-brown mark near it; the adjoining white spot with a yellowish cast.

Thoracic legs translucent green. Prolegs translucent green, with a dark band encircling their lower extremity; distal margins and crochets dark brown. Ventral surface, mottled yellow-green and darker green.

Fifth instar: (Fig. 5, 6) Length, fully extended, 45 mm. Width through center, 7.5 mm.

Head width 4.25 mm. Ground color of head yellow-green; center of front dark green, shading to yellow laterally. Center of maxilla and mandibles colored similarly to front. Each side of head capsule crossed longitudinally by two greenish bars (See Fig. 6) superimposed on a yellow-green base. Antennae, green proximally, yellow distally. Three of the ocelli on each side black, the remainder translucent.

Ground color of body, rich green, of same tone as juniper foliage.

A longitudinal wide bar or line of large red-brown spots middorsally, discontinuous on the first four or five segments, becoming confluent caudally. Along lateral edge of these large spots a line of conspicuous, raised, white spots, running from the meso thoracic segment to cauda. A similar line of white spots parallel dorsolaterally. A third line of large triangulate raised spots running along spiracles yellow-brown; spiracles resting on upper margin of these spots, conspicuously black, with narrow white rims.

Caudal horn stubby, short (2.35 mm in length), green, tipped with yellow; resting on an elevated, red-brown base.

Body segments ridged transversely, each segment with from seven to ten ridges, along edges of which are lines of minute white dots.

Thoracic legs green with brown tips. Prolegs, green, with pinkish-brown crochets.

A single larva was used for the description and drawing of this instar having been reared from eggs deposited by the confined female taken on July 31, 1965.

PUPA: (Fig. 7) Length 28 mm. Width through midthoracic area 8 mm. Head and thorax dark brown. Eyes not prominent. Wings tinged with green, sufficiently translucent to faintly indicate the underlying segmental lines.

Glossotheca (tongue case) relatively short (approximately 5 mm), curving toward body, resting on ventral surface of thorax; expanding at base, tapering caudally. Thoracic segments reddish-brown. Antennae extending two-thirds the distance toward wing tips, shorter than maxillae.

Cremaster dark, conical, tapering to a point, from which two small spines extend distally.

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THE MONARCH BUTTERFLY (DANAIDAE) IN NORTHERN SASKATCHEWAN

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There seems to be little known about the northern distribution of the monarch, *Danaus plexippus* (L.), in Canada. This species is the best known butterfly migrant; it migrates southward in the fall to the southern United States before the advent of heavy frosts in Saskatchewan. In the Riding Mountains of Manitoba occasional stragglers will linger into mid-September as I observed in 1962, while in southern Manitoba fresh individuals can be netted around Winnipeg into the third week of September. Very likely these do not survive the cold weather. The monarch is actually abundant during some years around the outskirts of Winnipeg, but apparently no records of mass movements exist in the literature for the Winnipeg area. It is. nevertheless, quite likely that these movements do occur.

During fifteen years of rather intensive butterfly collecting in the area of The Pas, Manitoba, 500 miles north of Winnipeg, I have not seen a single individual of the monarch. From time to time dismembered specimens are found around garages at The Pas. These probably have fallen

from the insect screens of cars arriving from areas much further south.

In view of the foregoing remarks I was surprised to see a specimen of the monarch collected at Cookson, Saskatchewan, a locality 25 miles north of Shell Brook near Prince Albert. The worn specimen was collected by Kenneth Cole, a high school student, in mid-June, 1964, at flowers of lilac on the Cole farm. Although only one monarch was taken, five others were on the lilacs at the same time. This specimen is now in the writer's collection at The Pas.

During the following season only one individual was seen; it was flying in a garden at Cookson. This would seem to indicate that the return spring migration of the monarch reaches into the Prince Albert area. This is a considerable extension of its known range as defined by F. Urquhart (1960) who reported rare collections at Duval, 40 miles north of Regina and also at Furness, Saskatchewan, near the Alberta border, some 20 airline miles south of Cookson's latitude.

At this latitude the species cannot become established because its food plant, milkweed (*Asclepias* spp.), does not occur this far north. Apparently, *Asclepias ovalifolia*, the usual food plant on the prairies, is also spreading in range. Formerly it was a typical, black-soil prairie species but now thrives in gravel and clay of railway embankments in spots such as on the outskirts of Winnipeg. This portends a future spread and establishment of the monarch in areas from which it is at present completely absent. It is a southern species now venturing to the 53° parallel on the prairies. Its sailing flight and ability to fly great distances has enabled it to spread to distant areas and to become established in those areas where its food plant has been introduced.

The viceroy, *Limenitis archippus* Cramer, is similar in appearance to the monarch and is believed to mimic the monarch. The viceroy is part of the butterfly fauna to at least the 55° parallel in Manitoba (Lynn Lake, Manitoba specimen in the writer's collection taken in 1958). Thus, the viceroy extends some 400 miles northward of the most northern records for the monarch. It is strange that the viceroy's model should only now be extending its range northward within the distribution of the viceroy. It would be interesting to know if the protection gained by the viceroy has application in northern latitudes.

The present records, one collected specimen and flight records of six others, at Cookson, Saskatchewan considerably extend our knowledge of the northward range of the monarch in Canada.

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NOTES ON UNCOMMON MOTHS IN CENTRAL AND SOUTHERN ONTARIO

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For the past few years a program has been under way in the Department of Entomology of the Royal Ontario Museum to conduct a fairly intensive faunal survey of the larger Lepidoptera in southern and central Ontario. Thus far, our own field work involving Lepidoptera has been spread over several widely separated localities within this area: Sudbury, One Sided Lake (Rainy River District), Chaffeys Locks, Rondeau Provincial Park, Pelee Island and Algonquin Provincial Park.

Added to these materials have been several very significant collections from other parts of the Province: collections from S. Neebing Township, Thunder Bay District, by W. Hartley; from Dunnville and Crystal Lake near Mt. Irwin by W. Plath Sr. and W. Plath Jr.; from Severn Bridge by G. E. Scott.

Except for the bulk of the noctuids and geometrids, this material has now been identified. For the other groups our survey of the fauna of Ontario appears now to be largely complete. Not surprisingly, it includes a number of moth species for which these collections are the first records in Ontario, or in Canada. These are summarized here, along with range extensions and new locality records for several uncommon species previously known from Ontario.

Limacodidae

Sisyrosea textula (Herrich-Schaeffer) was known in Ontario only from a few specimens from St. Williams and Simcoe on the north shore of Lake Erie. It flies in July and was recently taken in Dunnville and Rondeau Park.

Prolimacodes scapha (Harris), known previously only from the southernmost part of the deciduous forest region, lying along the north shore of Lake Erie, was captured at Crystal Lake near Mt. Irwin (Peterborough Co.), about 60 miles north of Port Hope on the north shore of Lake Ontario, at the end of July.

Packardia elegans (Packard), also known in the past only from southernmost parts of the deciduous forest region was captured at Crystal Lake, too, in mid-June. This is a rather unexpected occurrence.

Heterogenea shurtleffi Packard was known in our region previously

only from Alcove, Qué. (specimens in the Canadian National Collection). It also occurs in Ontario at Chaffeys Locks where it was taken in some numbers in July 1963 and 1964.

PYROMORPHIDAE

Harrisina americana (Guérin) was known to fly around Point Pelee. During the last few years it has been found in Dunnville and in Rondeau Park where it is not uncommon. It occurs also on Pelee Island. Like the Euchromids (Syntomids) it flies both in the day and at night, visiting flowers, and coming to light sources.

COSSIDAE

Prionoxystus macmurtrei (Guérin), may be mentioned here, although we have many specimens of this species from Toronto in the collection of the Royal Ontario Museum. Additional specimens are known from Fort William, Macdiarmid, Chaffeys Locks, and Rondeau Park. The range given by Forbes (1923) is: New York to Minnesota; which corroborates what would otherwise seem to be "displaced" records from the country west of Lake Superior.

LACOSOMIDAE

Lacosoma chiridotum Grote, known in Ontario only from one male reared from a pupa found by the Forest Insect Survey in St. Williams, 1950 (specimen in the Canadian National Collection), was found in Rondeau Park in late June and early July.

Cicinnus melsheimeri (Harris), known from a few specimens taken between 1932 and 1957 in Ancaster, Chatham, Dunnville, London, Normandale and Port Colborne, was also found in Rondeau Park in late June and early July.

Both species of this family come readily to light sources. They fly mainly after midnight.

SATURNIIDAE

Syssphinx (*Sphingicampa*) *bicolor* (Harris), which was reported in a previous paper (Riotte, 1964), is known in Canada only from Brantford, Dunnville and Woodbridge, all in Ontario. Somewhat surprisingly, it was not found during our field work in Rondeau Park, and there is no specimen of it in the insect collection of the Rondeau Provincial Park Museum.

Hyalophora (*Callosamia*) *angulifera* (Walker), a tulip tree feeder, was taken for the first time in Canada in Rondeau Park, where tulip tree is common, on June 23, 1965.

Zanolidae

Apatelodes torrefacta (J. E. Smith), is now known from Dunnville, Grand Bend, Harrow, London, Normandale, Port Colborne, Queenston and Rondeau Park. There are, however, no records of this species east of the Niagara escarpment. It seems to be restricted to the north shore of Lake Erie. It flies from late June through late July.

Apatelodes angelica (Grote), in contrast, has a distribution including the Carolinian zone in Ontario along Lake Erie and along the north shore of Lake Ontario eastward to around Kingston. There are specimens from Dunnville, Grand Bend, Normandale, Rondeau Park, Simcoe, Queenston, Trenton, Belleville and Chaffeys Locks. It was found to be quite common in Chaffeys Locks where up to nine specimens in one season have been taken.

Both species come readily to light sources, *torrefacta* flying around 11 p.m., *angelica* in the early morning hours, during mid-June to end of July.

Lasiocampidae

Heteropacha rileyana Harvey, is known in Ontario from only one specimen, caught in a light trap at the Entomology Laboratory in Chatham, on May 25, 1931. Although the collecting in Rondeau Park was begun in the midst of May, no specimens of this species were obtained. In recent years, however, the species was found to be common in southern Michigan (M. C. Nielsen, *in litt.*), about 110 miles southwest of Rondeau Park.

Notodontidae

Most of the observations and additions to our knowledge have been made in this family.

Clostera strigosa (Grote), is distributed over the Province in an erratic pattern. It has now been taken, although in low numbers, in Algonquin Park, Black Sturgeon Lake, Chaffeys Locks, Dunnville, Geraldton, Grand Bend, Macdiarmid, Nakina, S. Neebing Township (Thunder Bay District), Nipigon, Ottawa, Port Elgin and Spragge.

Clostera inclusa (Hübner), the more southern member of the *albosigma* group, was previously known from Grand Bend, Leamington, Port Colborne, Port Franks, Turkey Point, and now a few specimens have been taken in Rondeau Park, May 22 to June 5, 1965. It probably has a second, at least partial, generation in Ontario, in late July.

Clostera brucei (Hy. Edwards), occurs in the northern part of central Ontario (Sudbury, Geraldton), in northern Ontario *s. str.* (Smoky Falls), and in western Ontario (One Sided Lake, Rainy River District).

Datana angusii Grote and Robinson, which in the *Forest Lepidoptera of Canada* (Prentice, 1962) is said to be "limited to the north shore of Lake Erie in southern Ontario; following closely the limits of the host trees" (shagbark hickory and butternut), was found almost commonly in Chaffeys Locks (Leeds Co.). It is known from Chaffeys Locks, Chatham, Crystal Lake near Mt. Irwin, Coldstream, Jordan, Marmora, Merivale, Ottawa, Port Colborne, Port Rowan, Rondeau Park, Simcoe, St. Davids, St. Williams, Toronto and Vittoria.

Datana perspicua Grote and Robinson, not only occurs in southern Ontario, as Forbes (1948) says, but is found in the southern part of central Ontario to Manitoulin Island and Muskoka District. It is known from Bracebridge, Brantford, Cape Croker, Cedar Springs, Chaffeys Locks, Grand Bend, Hamilton, Kingston, Manitoulin, Pinery Park, Ridgetown, Southampton, Square Bay and Westbrook.

Datana drexelii Hy. Edwards, has a similar, but more restricted distribution: Ancaster, Hamilton, Normandale, Port Colborne, Teeswater, Toronto, Vittoria, West Hill. Forbes (1948) states, "Canada."

Gluphisia lintneri (Grote), is much more widespread than previously thought, but is taken only rarely because of its very early flight period, at the end of April and beginning of May. It seems to occur in "pockets" up to northern Ontario *s. str.* It is known from Barrie, Black Sturgeon Lake, Marmora, S. Neebing Township (Thunder Bay District), Seven Bridge, Smoky Falls, Spragge, Westbrook. There is a substantial series in the Royal Ontario Museum from Severn Bridge.

Dasylophia anguina (J. E. Smith), is a western species which penetrates into western Ontario (west of the Nipigon River to the Manitoba border). Specimens are known from S. Neebing Township (Thunder Bay District) and One Sided Lake (Rainy River District).

Dasylophia thyatiroides (Walker), occurs in both forms, the typical and the melanic. The ranges of the two forms are practically identical. Most of our specimens have been taken in southern Ontario, and the species does not occur to the north of Algonquin Park (*Peridea* (*Peridea*) *basitriens* Walker has a similar distribution). *D. thyatiroides* has been taken in Algonquin Park, Chaffeys Locks, Coldstream, Dunnville, Grand Bend, Hamilton, London, Ottawa, Port Colborne, Ridgeway, Rondeau Park and Toronto.

Hyparpax aurora (J. E. Smith), until recently was known in Ontario only from a single specimen in the Canadian National Collection, from Grand Bend, collected on June 17, 1936. The species was taken in 1965 in Rondeau Park, July 11, giving evidence that it has at least a partial second generation.

Schizura apicalis (Grote and Robinson), was not known from Ontario until our survey. It is now known from a few specimens collected in areas scattered over the Province, except the far southern portion. It has been found at Burleigh Township (Peterborough Co.), Chaffeys Locks, One Sided Lake (Rainy River District) and Sudbury, where it was taken for the first time on July 29, 1960.

Heterocampa subrotata Harvey, is another of the species which was taken in Canada for the first time in 1965. It was found to be on Pelee Island where its foodplant, hackberry, is the most abundant tree. It may be expected to occur on the southernmost point of the mainland (Point Pelee) and wherever hackberry is found (around Belleville and St. Catharines, *e.g.*). A few years ago it was taken, in southern Michigan for the first time, in Lenawee County (M. C. Nielsen *in litt.*), about 70 miles west of Pelee Island.

Macrurocampa marthesia manitobensis McDunnough, occurs in Ontario in the vicinity of the Lake of the Woods, near the Manitoba border. It was first taken in Ontario by a collecting party from the Canada Department of Agriculture in 1960 and then by the author in 1962 at One Sided Lake (Rainy River District) and Rainy River. Forbes (1948) says, "solidly gray, without white, but with green splashes." The splashes are, however, orange-brown, and n o t green (which is also true of the types). The nominate subspecies, which is common over the southern part of the Province, usually shows, when fresh, "g r e e n splashes."

Cerura (*Cerura*) *multiscripta canadensis* McDunnough, is one of the rarest notodontids in Ontario. The locality records are scattered over the Province as follows: Barrie, Galt, Midhurst, Norway Point (Lake of Bays), One Sided Lake (Rainy River District), Ottawa, Sioux Lookout, Sudbury, Tomiko and the latest record, Crystal Lake near Mt. Irwin. It flies only for a brief period early in June.

Lymantriidae

Orgyia (*Hemerocampa*) *plagiata* (Walker), is sporadically found in southern Ontario, and is probably never very numerous. Males are known from Belleville, Chaffeys Locks, London, Ottawa and Trenton. In Chaffeys Locks a caterpillar with the characteristic yellow head and body was found on maple and developed into a female. Additional locality records from the Forest Insect Survey (Can. Dept. For.) are Chatham, Chatsworth, Dunnville, Hamilton, Hornings Mills, London, Newbury, Oakville, Oshawa, Petrolia, Port Stanley, Powassan, Ridgetown, St. Williams, Tillsonburg, Trenton.

NOCTUIDAE

Psychomorpha epimenis (Drury), is found in Ontario on Pelee Island. It was not observed in Canada prior to our survey in 1965. The writer also took it as far north as Madison, Wisconsin, on April 29, 1963. The range, given by Forbes (1954) is eastern Massachusetts to Kansas and Missouri, south to Texas.

ARCTIIDAE

Phragmatobia lineata Newman and Donahue. One of the paratypes of this recently described species (Donahue and Newman, 1966) was taken on July 9, 1965, in Rondeau Park. Another specimen is in the Park Museum (June 29, 1959), and a second paratype is in the collection of W. Plath, Sr., having been taken at Dunnville, July 20, 1958.

Haploa clymene (Brown), has been known from the Carolinian zone in Ontario for years, but is represented by only a few specimens in collections. Verification of its breeding status in the Province was needed. Adults were known from Dunnville, Hamilton, Hyde Park Corner and London. The Rondeau Park Museum had two specimens reared from caterpillars found in the Park on *Eupatorium* in 1959. One of the specimens is now in the collection of the Royal Ontario Museum.

Haploa militaris (Harris) and *Haploa fulvicosta* (Clemens), are the other two entities, of uncertain specific status, in this genus, which occur in Ontario only in Rondeau Park and on Pelee Island. They fly at the end of June and the beginning of July.

Cisthene unifascia Grote and Robinson, was represented by only three old specimens from London, Ontario, collected in 1886 and 1896. These specimens, most of which lack abdomens, are in the collections of the Ontario Agricultural College, University of Guelph, and the Royal Ontario Museum. Prior to 1963, when one fresh female was taken on July 13 in Chaffeys Locks, the old records seemed doubtful. Forbes (1960) does not mention *unifascia* at all but only *tenuifascia*. The four Ontario specimens, however, look rather similar to *unifascia*, and they had been so identified in both collections.

Callarctia (*Callarctia*) *quenselii gelida* (Moeschler), does not occur in central or southern Ontario. The unique specimen in the collection of the Royal Ontario Museum was taken at Cape Henrietta Maria on the Ontario tundra (Hudson Bay shore) by one of the previous field parties of the Royal Ontario Museum, July 7, 1948.

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A MIGRATION OF *VANESSA CARDUI* (NYMPHALIDAE) IN MONTANA AND WYOMING

The summer of 1965 saw unusually heavy flights of the Painted Lady, *Vanessa cardui* (Linnaeus), in Montana, Wyoming and adjacent areas. One could see the butterflies rapidly crossing the highway in western Nebraska and growing gradually more numerous to the west. At a vantage point in Scottsbluff National Monument I counted 70 individuals fly past in a half hour. Every individual netted was found to be worn and faded, evidently the result of many miles of flight. The flight direction was from due south to north. Across the sage covered wastes of central Wyoming we continued to see scattered individuals of *cardui* always flying in a constant south to north direction. Just south of Worland the heaviest flight in Wyoming that we witnessed was seen. Several hundred individuals flew past us in one group within a few minutes.

The next day, July 5th, we spent in the Tetons. Here *cardui* was the most abundant butterfly, and here perfect, fresh individuals were discovered amid the old, worn ones. On thistles in the park I found dozens of caterpillars amid the characteristic white webs, which had been produced in a short time by the migrants. The comparative ease with which I was able to net these fresh *cardui* in contrast with the wary migrants made me wonder if the freshly emerged individuals join in the flight of their parents or if they remain in the area in which they had developed.

We spent July 6th in Yellowstone National Park. No *cardui* were seen all that day, but the day was cloudy and almost no butterfly activity was observed. The next morning was clear and sunny and we noted a reappearance of *cardui* along the Madison River in Montana. They were

flying in their usual northward flight direction and were not too numerous. We stopped briefly at Quake Lake. With our binoculars we could see *cardui* flying past.

At 11:00 A.M. we detoured off the main highway and drove westward to the tiny town of Pony which is situated at the foot of 10,500 foot Hollow Top Mountain, one of southern Montana's highest peaks. The road above Pony was not negotiable for our car. As I ascended the trail above Pony in search of butterflies *V. cardui* became more numerous. After a three-hour hike I came near a precipice on the east face of the mountain and saw a startling sight. An approaching horde of *cardui* was flying towards me in "waves." As each wave of butterflies flew past another came into view. Each wave must have contained many hundreds or even thousands of individuals. As I looked up they were flying both above and below me and each wave flew due north and disappeared on the far side of the east shoulder of Hollow Top Mountain. This was the heaviest flight I had yet seen, and as I held out my net I scooped in dozens in one sweep. I could have easily repeated this capture many times. In 20 minutes the last wave of *cardui* had flown past and no more were seen. This spectacle took place at 3:00 P.M. on July 7, on the east slope of Hollow Top Mountain in Madison County, Montana, at an approximate elevation of 6,500 feet. The day was sunny, quite warm, and there was no appreciable wind. Most individuals were flying only about four to ten feet above the ground, although some were flying higher. This Montana flight is the heaviest I have witnessed.

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BOOK NOTICE

CONTRIBUTIONS TO THE INSECT FAUNA OF NEPAL. Part I (Special Bulletin of Lepid. Soc. Japan, No. 2). 129 pp., 5 color and 26 monochrome plates. Text in English. Price: equivalent of $5.50 U.S. (including surface rate postage).

The first installment of the report of the Expedition to Nepal Himalaya in 1963 by the Lepidopterological Society of Japan. It contains descriptions and ecology of immature stages of many swallowtail butterflies, a study of 12 kinds of interspecific hybrids between Himalayan and Japanese swallowtails and chromosome studies of Himalayan butterflies and their hybrids. A forthcoming issue will cover descriptions of new species and new records, etc. of butterflies, moths, and other insects.

Contents of Part I: Butterflies of Nepal (immature stages), by S. Igarashi; A study of hybrids between Japanese and Himalayan *Papilio*, by S. A. Ae; A chromosome study of twenty-eight species of Himalayan butterflies, and A chromosome study of interspecific hybrids of butterflies, both by K. Maeki and S. A. Ae.—Order from: S. A. AE, *Biol Lab., Nanzan University, Yamazato-cho, Showa-ku, Nagoya, Japan.*

THE BIOLOGY OF *PAPILIO INDRA KAIBABENSIS* IN THE GRAND CANYON

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Of the six races of *Papilio indra* Edwards, *P. i. kaibabensis* Bauer inhabits perhaps the most spectacular country in which a butterfly may be found, the sheer cliffs and rugged gorges forming the Grand Canyon of the Colorado River in northern Arizona. This swallowtail was first noted to occur in Arizona sixteen years ago (Garth, 1950) and was described as a distinct subspecies in 1955 by Bauer. Few specimens have been collected since those of the type series, almost all at the top of the rims within Grand Canyon National Park in the month of August. Nothing on the biology of this butterfly has been recorded. The present paper reports data on the ecology, distribution, and life history of *Papilio indra kaibabensis* obtained from three years of field work in the Grand Canyon. The affinity of *kaibabensis* with the *P. indra* group is corroborated by our data.

Since the type locality of *P. i. kaibabensis* is Bright Angel Point, on the North Rim of the Grand Canyon, the authors first visited this area on August 7–9, 1963. It rained daily and adults were not seen; searching of the slopes and rim around Bright Angel Point did not uncover a possible umbellifer foodplant.

The following year, we returned to the Grand Canyon to explore the lower Canyon area around Roaring Springs, another North Rim locality where this *Papilio* was known to occur. On August 22, one of us (J.F.E.) made the five-mile hike down the North Kaibab Trail. A large female *P. i. kaibabensis* was observed flying on the steep slope opposite Roaring Springs, and it attempted to oviposit on an umbelliferous plant. The butterfly was netted and kept alive, in the hope that it would be induced to oviposit (unfortunately it died the following day). In the next few hours, only three other females were seen, and one was collected. During this time, the umbelliferous plants on the slope were searched for larvae. One third-instar larva was found, and specimens of the plant were taken for identification. The single larva was reared to the fifth-instar on an intact specimen of the foodplant, but it died of disease.

In July of 1965, one of us (T.C.E.), in company with field assistant, M. K. Fosdick, revisited the Grand Canyon with the intention of finding more immature stages. On July 3, the 4,000 foot descent to the Roaring Springs area was made. A fresh male *kaibabensis* was taken on wet

sand at the spring area, and several other rather worn adults were seen. On the abundant foodplants, six larvae were found: one second-instar, one third instar, three fourth-instars, and one fifth-instar. The fifth-instar larva prepared for pupation soon after collection and the resulting pupa went into diapause; the remaining five larvae were sent to J.F.E. at Stanford University for rearing. On arrival, the second-instar was dead and the third-instar had molted. The four living larvae were placed singly on separate potted plants of *Tauschia arguta* (T. & G.) Macbr., a known foodplant of *P. i. pergamus* Hy. Edw. (Emmel & Emmel, 1963). All accepted the *Tauschia* readily and three reached maturity; the fourth was killed by ants while in the fourth-instar.

The three mature larvae all pupated successfully; one pupa died several weeks after formation from virus disease. The remaining two pupae emerged on July 28, 1965, only ten days after pupation on July 18.

Description of Foodplant

The foodplant at Roaring Springs was identified as *Pteryxia petraea* (Jones) Coult. & Rose, using *Arizona Flora* by Kearney and Peebles (1960: p. 619). This identification was further verified by comparison of our specimens with numerous herbarium specimens of *P. petraea.*

The broad range of this plant includes extreme eastern Oregon, southern Idaho, northeastern California, and the northern half of Nevada. In Arizona the plant is found only in the Grand Canyon, where it occurs on the slopes of both rims. The four herbarium specimens of *Pteryxia petraea* at the Grand Canyon National Park Museum are from the South Rim: from 6,000 to 4,250 feet elevations on the Hermit Trail and at 7,000 feet on the South Kaibab Trail. Our work on the North Rim shows that it is abundant from 4,800 to 5,200 feet elevation on dry rocky slopes along the North Kaibab Trail. The plant may stand nearly two feet in height, and be the same size in diameter. Flowering occurs in May and June, and the herbage remains green into early September when summer rains are sufficient. This plant has a strong pungent odor detectable by a human observer from even several feet away.

Habitat

The *Pteryxia* plants were found generally scattered on the open sunny slopes or even vertical canyon walls in the vicinity of Roaring Springs, in the arid Pinyon-Juniper belt or Upper Sonoran Life Zone. This area is about 2,000 feet lower in elevation than the Mesa County, Colorado, habitat of *Papilio indra minori*, but the general plant associations and rocky-slope habitat of these two *P. indra* races are the same.

Fig. 1. The Grand Canyon of the Colorado River, Arizona, from Cape Royal on the North Rim. Male *Papilio indra kaibabensis* have been taken here, but the main breeding area is located below even the lowest rock strata visible in this photograph.

Adult Habits

The observed *P. i. kaibabensis* males were either taking water at mud flats along the stream at Roaring Springs or flying rapidly along the stream bottom. Most of the males (and the several females) of the type series were taken on the top of the North or South Rims (Bauer, 1955), and it is likely that the males "hill-top" like males of other *P. indra* races (even though they may ascend several thousand feet higher than their nearest foodplants, where the fresh unmated females would presumably be found!). The observed females flew rather slowly across the slopes around Roaring Springs, occasionally hovering around the outer leaves

of a *Pteryxia* plant. A tall thistle (*Cirsium* sp.) has been the only observed nectar source for the adults.

This subspecies is double-brooded, as evidenced by the presence of young larvae at the beginning of July and again in August, the immediate emergence of two of the four pupae obtained from early-July larvae, and the temporal distribution of adult specimens in collections and in our field visits. All but one specimen of the type series were taken in August (usually mid to late August), and would therefore be second brood specimens. The other type specimen was taken July 1, and our own early-July visit showed adults flying at that time. Considering the larval instars (even a fifth-instar) taken July 3, the first brood must fly from late May into early July.

Data obtained since the publication of our paper (Emmel & Emmel, 1964) on the life history of *Papilio indra minori* indicates that *P. i. minori* also has a second brood in mid summer. At present, then, two of the six subspecies of *Papilio indra* are known to have two broods a year while the other four are apparently single-brooded.

Larval Habits

As in other *P. indra* subspecies, the larval habits differ among the instars. The fourth-instars remained on the petioles of the foodplant, near the base, moving to the tip of the leaf to feed. Larvae of this instar often dropped from the plant when disturbed. When not feeding, fifth-instar larvae rested near the base of the plant, under old leaves or prostrate stems. Larvae fed most heavily during the daylight hours, but also fed at night. For several hours before selecting a pupation site, the larva traveled rapidly around the potted *Tauschia* plant, stopping only when disturbed.

Description of Early Stages

Egg and First-Instar Larva:

No examples have been obtained, but considering the close similarity of later stages to those of *Papilio indra minori*, the egg and first-instar are probably similar to those of this western Colorado subspecies.

Second- and Third-Instar Larvae:

The general coloration and pattern is similar to that of the fourth-instar larva described below, except that the head is shiny black before the larva reaches fourth-instar.

Fourth-Instar Larva:

Length: 25 mm at maturity.

Head: Width of head capsule, 2.1 mm. Shiny jet black, with an inverted crescent-shaped mark of light orange at center and four white dots across upper margins (one pair on each side).

Body: Pattern indistinguishable from that of fourth-instar larva of *Papilio indra minori* (see Figures 2 and 3, and Emmel & Emmel, 1964). Ground color black; three rows of orange spots on each side of larva; position and shape of white "saddle" mark (on seventh abdominal segment) and other white spots as on larva of *P. i. minori*.

Fifth-Instar Larva:

Length: 42 mm at maturity, the largest of any *P. indra* race.

Head: Width of head capsule, 4.0 mm. Head capsule pattern (Figure 6) and its slight variation between larvae essentially identical to that of *P. i. minori*. Light areas in pattern red-orange, the dark areas in both subspecies black.

Body: (Figures 4 and 5). Ground color deep black. Middle of each body segment with six orange spots, three on each side (dorsal, suprastigmatal, lateral); these spots in same positions as orange spots on larvae of younger instars. First segment with a narrow anterior band of rich pink; this pink band expanding to cover anterior half of each succeeding segment, always ending posteriorly and laterally at the orange spots. Thoracic legs and abdominal prolegs black, with a medium to large white dot on each. An analogous, single subventral white dot on segments without legs, but not on anal proleg pair (where it is almost always present on *P. i. minori* larvae).

After careful comparison of these *kaibabensis* larvae with preserved examples and color transparency slides of larvae of *P. indra minori*, we conclude that the pattern and general coloration of the fifth-instar larvae of the two subspecies are essentially identical. The *P. indra kaibabensis* larvae differ only in their slightly larger size at maturity and the absence of the white spot on the rear proleg. This similarity is surprising when one considers the degree of larval color pattern divergence in the other *P. indra* subspecies, although it is clear from adult characters that *kaibabensis* and *minori* are closer to each other than to any of the remaining four races. The pupal coloration of *kaibabensis*, however, is quite distinctive.

Pupa

Male: Length, 27.5 mm. Greatest width at wing cases, 9.5 mm.
Female: Length, 30–31 mm. Greatest width at wing cases, 10 mm.

Morphologically, the pupa is identical to that of *P. i. minori*. It is also identical in size to large pupae of *minori*. However, it may be distinguished readily from pupae of all other *P. indra* subspecies in its coloration. The ground color is best described as a light tannish *pink*; pupae of *P. i. minori* are grayish tan or brownish tan in comparison. A finely mottled appearance is given by a rough surface with scattered tiny light

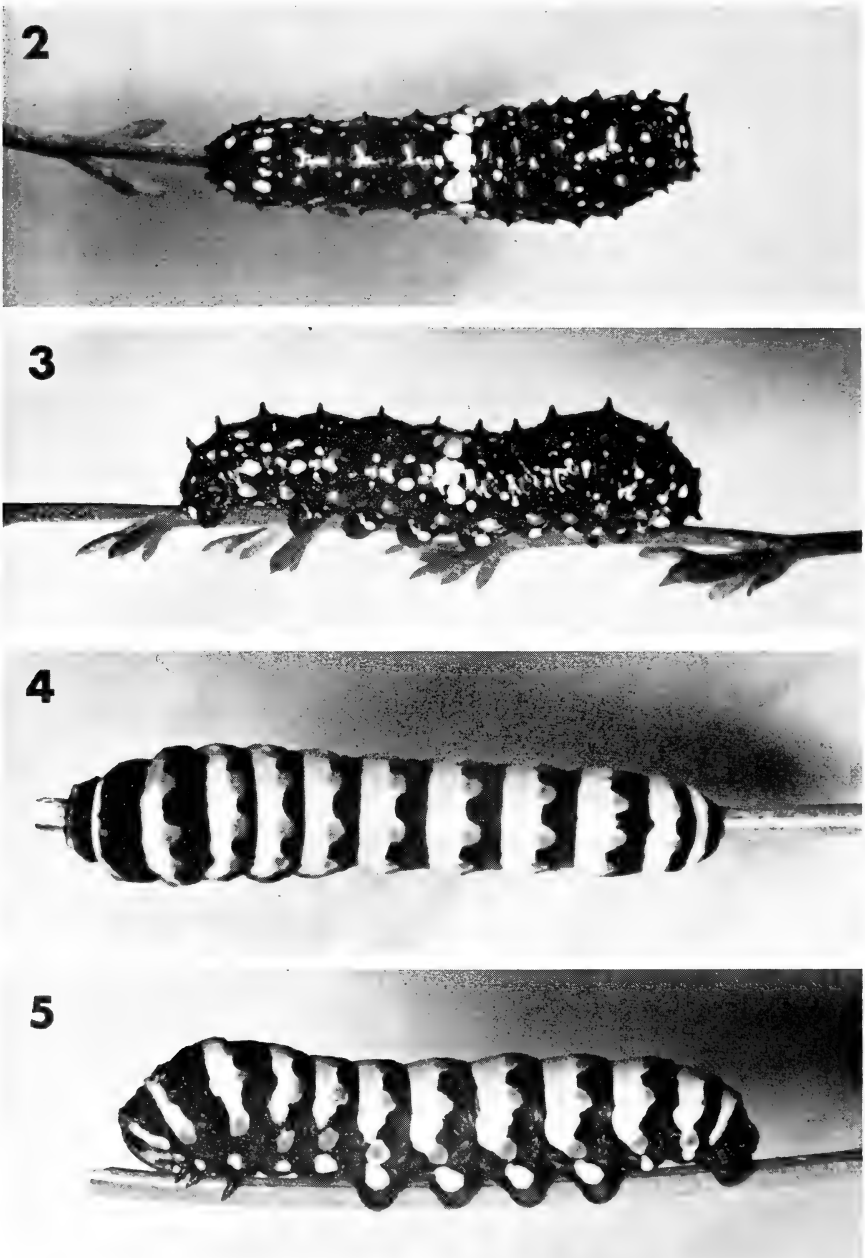

Fig. 2. *Papilio indra kaibabensis* Bauer. Fourth-instar larva, dorsal aspect. Fig. 3. Fourth-instar larva, lateral aspect. Fig. 4. Fifth- (last) instar larva, dorsal aspect. Fig. 5. Fifth-instar larva, lateral aspect.

cream-colored spots, the spots occurring on the raised portions of the surface. There are also various other scattered marks of a dark tannish pink. The light spots are more concentrated in the dorsal region, giving this area a lighter color than the surrounding tannish pink. The wing cases have much less mottling.

Distribution of the Subspecies

The twenty-one specimens of *Papilio indra kaibabensis* in the Grand Canyon National Park Museum collection were collected at five different localities:

Bright Angel Point (17 specimens): 8/3/38, 8/13/51, 8/2/53 (2), 8/4/53 (2), 8/5/53 (4), 8/7/53 (2), 8/13/53, 8/14/53 (2), 8/16/53 (2). Point Imperial (1): 7/28/53. Cape Royal (1): 7/29/53. Roaring Springs (1): 8/18/53. Yavapai Point (1): 8/22/44.

All the specimens but one (Yavapai Point) came from the North Rim of the Grand Canyon, and all represent second-brood adults. Bauer (1955) took one male, near Ryan Ranger Station, Kaibab Plateau, Coconino Co., Arizona, on 1 July 1952.

From our field work in the Grand Canyon area and the distribution of foodplants and museum specimens, it appears that the butterfly breeds in a narrow altitudinal zone at about 5,000 feet elevation, halfway between the North Rim (and probably also the South Rim) and the floor of the Grand Canyon.

Summary

The life history stages and foodplant of *Papilio indra kaibabensis* are described from field work on the North Rim of the Grand Canyon. The life history is very similar to that of *P. i. minori*; both races are double-brooded. The foodplant is *Pteryxia petraea* (Jones) Coult. & Rose, a member of the Umbelliferae. Remarks on the ecology of the adults and larvae and known distribution of this Grand Canyon race are also given.

It is clear from the characters of the immature stages that Bauer (1955) was correct in associating this black *Papilio* with the *P. indra* group rather than with the superficially similar adults of *P. bairdi*, or another *Papilio*. It is also evident that *P. indra kaibabensis* and *P. i. minori* have diverged from each other mainly in adult characteristics, which suggests that characteristics of the immature stages in these butterflies are evolving less rapidly than those of the adults. This conservatism in larval divergence is all the more surprising when one compares these larvae with those of the other *indra* subspecies, which have diverged considerably.

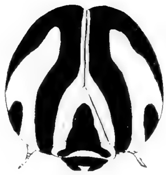

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Fig. 6. *Papilio indra kaibabensis* Bauer. Detail of the head of the fifth-instar larva, frontal view. Dark areas black, light areas orange. Fig. 7, 8, 9. Pupa. Dorsal, lateral, and ventral aspects, respectively.

ACKNOWLEDGMENTS

The present paper is part of a continuing study of evolution in populations of the *Papilio machaon* complex in western North America. The support of the U. S. Public Health Service Population Biology Training Grant to Stanford is gratefully acknowledged.

We wish to thank Park Superintendent Howard B. Stricklin and Chief Park Naturalist Merrill D. Beal of the National Park Service for their most helpful cooperation in granting collecting permits and answering our many requests for information; Mr. Michael K. Fosdick for his capable assistance in field work; and Dr. William M. Hiesey, Director of the Division of Plant Biology, Carnegie Institution of Washington at Stanford, for generously providing research space for culturing both foodplants and *Papilio* stocks.

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NOTES ON TROGONOPTERA TROJANA OF PALAWAN—PHILIPPINES

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One week before the outbreak of the war in the Pacific in 1941, the picture of both sexes of the *Trogonoptera trojana* (identified as *Ornithoptera trojana*) appeared in the magazine section of the then widely circulated *Tribune*, a Manila daily. In part the short article reads: "A certain ornithoptera for instance, (found only in Palawan), is said to cost $250, highest price for a P.I. butterfly; its male, $75. According to the late Prof. C. S. Banks, there are only two existing specimens of this, one of which is in a German museum, the other, in the P.I. Division of Natural History Museum." When the Bureau of Science building in Manila was destroyed during the liberation campaign, all the scientific records and collections were lost. Since then, the writer has never heard anything about this butterfly nor came across papers about it. It is evident that the trickle of scientific expeditions which have extended their field work to Palawan have not succeeded in collecting specimens of this birdwing.

In 1959, accompanied by three zoology instructors from the University of San Carlos of Cebu City, Philippines, the writer collected for nearly two months at central Palawan. Based at Irawan, 14 kilometers from the capital (Puerto Princesa), each day the party worked out the foothills of Staveley Mountain, following the chromite mine road which winds upward toward the mine, 14 kilometers from Irawan. The road cuts across a dense second growth vegetation where there were ample flowering bushes such as lantana and vines which attracted a host of pierids, danaids, and nymphalids. Before covering the entire length of the road, one gradually enters the primary forest where the predominating important trees are almaciga (*Agathis alba*) and apitong (*Dipterocarpus grandifloris*). Here, at an elevation of 300–400 meters, the party noticed huge black birdwings soaring more than 30 feet above the vegetation. Not only did none in the party have the chance to swing a net at those high-flying insects, but we did not even see the upper surface of those soaring beauties.

In September, 1965, the Smithsonian Institution, Washington, D. C., sent out a one-man expedition to the Philippines to collect moths, with emphasis on the Islands' Microlepidoptera. Dr. Donald R. Davis, Associate Curator of the Division of Entomology at the Smithsonian se-

lected four strategic localities for light-trapping. One month was spent in Cebu and western Leyte, a full month at Davao on Mindanao, five weeks at central and southern Palawan, and finally in Baguio, on northern Luzon. According to previous arrangements, the writer agreed to accompany Dr. Davis at the first four places. The party arrived at Palawan on the last week of November. Therefore we were at Palawan when it was neither too rainy nor too dry. The rains were occasional at central Palawan, but an easterly wind made most of the days partly cloudy, with, at times, a stiff breeze which made the upper lanes of the forest too uncomfortable for these huge birdwings.

The party was based for ten days on the chromite mine site in the midst of the Almaciga and Apitong forest. The mine road runs further west for several kilometers. The surrounding ranges have an elevation of 2,000–3,000 feet and are covered with a primary forest. Here a species of climbing *Bauhinia* is in bloom during the last three months of the year. Its pods ripen in summer or the hot months of the Philippines. The inflorescence of this vine attract a number of butterflies. Among the papilionids observed to regularly visit the flowers were *Lamproptera curius*, *Papilio palawanicus*, *P. demolion*, *Graphium agamemnon*, an occasional *G. sarpedon* and *P. polytes ledebouria*. It was sometime later when the party noticed that the *T. trojana* also favored this flower although it showed marked partiality for a certain vine while the others although profusely flowered, were bypassed.

This vine may sprawl on the ground like sweet potato, or grow upward, enveloping a whole shrub tree as was the case with our "bait" tree which yielded the greatest number of catch. This vine hugged a 15-foot tree, completely covering it, its scores of clusters of flowers shooting out in all directions. All around were smaller vines striving to reach sunshine, some of which appeared ideal for flower visitors but remained unpatronized by the *trojana*. The area is a depression with second growth forest of not more than 15 years. Possibly birdwings emerging from tall trees of surrounding mountainsides fly down into this area in search of flowers and mates, as well as to escape from the stiff breeze sweeping the top of the forest. Here, all kinds of vines, shrubs and herbs, exposed to sunlight, bloom in exuberance, hence the abundance of fluttering visitors on sunny mornings.

On slightly elevated ground 30 meters away, an eight-foot guava tree similarly choked by a *Bauhinia* vine, proved to be another nectar source favored by the *trojana*. Half a kilometer down the mining road several males and a female *trojana* were later taken at a sprawling vine. It was on the curve of the road facing the morning sun. For nine days, the

writer shuttled between the three spots from morning until sundown, and took two females and 24 males. Dr. Davis, also took a female and three males. The writer's assistant caught a female and six males. Of the chances afforded us in nine days, 30 to 40 percent were misses.

T. trojana is essentially a woodland butterfly like species of *Troides* of the islands. None was seen on the open spaces of the lowland where the black and yellow birdwings occur. Both sexes showed preference for the milder hours of the day. Shying the hot hours of bright days, they sought refuge in the cool shade of tall trees where they were usually seen ceaselessly soaring and gliding, recalling the habit of the male *Parides mariae* and *P. phegeus*. Some males were observed flying during a shower, and one was seen on the wing in a particularly heavy rain. Several males were taken while they fed during a drizzle. With their huge wings, they appeared to be at a great disadvantage during a strong wind. Some were taken while bracing a stiff breeze, when they were forced to fly lower in order to escape the wind. Of the 26 individuals taken by the writer, 18 were netted in the morning, and eight in the afternoon.

Both sexes feed early in the day, even on our side of the range where the sun appears about 9:00 A.M. The earliest catch was at about 6:00 A.M., and the latest was after 3:00 P.M. Of the four females taken, one was taken at 7:00 A.M., another at 11:00, on a cloudy day. One came to feed at 3:00 P.M. Several were seen hovering over thickets on slopes, and one fresh female was observed several times at a particular spot three meters above the roadside, leading to the writer's discovery of an *Aristolochia* vine which is very similar to *A. tagala*. An egg-laying female led to the finding of two larvae on the stem of another vine on the opposite side of the road. One, nearly 5 cm in length, was apparently hiding on the stem a meter from the ground. The smaller one was nearly 2 cm in length. The head of the larger one was black, its body brownish black with two dorsal rows of brown fleshy spines; the pair above the second false legs, and the last three pairs, together with two laterally placed below it were orange. There was a yellow ring between the head and the thorax. The small larva had the head and body brownish black, the spines pale orange. Neither reached pupation stage because the party moved down to southern Palawan soon after the discovery of the larvae. Both specimens are preserved in alcohol in the writer's collection.

Seitz (Macrolepidoptera of the World, vol. IX) described the forms of *brookiana* Wallengren of Borneo and Balabac, and *trojana* Staudinger of Palawan, giving the differences between them. The female *trojana* closely resembles that of *T. brookiana* of Malaya. However, in *trojana*,

the subapical white markings are only faintly indicated, not as vivid as in the Malayan form. The feather-like metallic green spots of the latter's forewing (dorsal) are well defined, while in *trojana*, these are reduced to narrow lines bordering the strong black veins. The hindwings above are nearly identical in the two species except that in *trojana*, a beautiful blue sheen runs from the base of the wing upward meeting the metallic green halfway discally.

Pendlebury and Corbet, as well as other observers, noted the extreme rarity of the females of the *T. brookiana*. The same is true of the Palawan birdwing. In the writer's experience, there was an average of one female for every 30 or more males seen. Of our group's total catch of 37 specimens, however, there are eight males to every female. This was because, after 15 males were captured, the writer and his companion concentrated on the rare females. Most of the half dozen or more females seen were perfect and fresh individuals. One came to the flowers briefly then flew in a spiral perpendicular to the ground until the butterfly was a mere speck overhead then made for the almaciga forest. About 20% of the males seen and taken were perfect although many of the damaged or imperfect ones were very fresh with only their hindwings showing a tear or two.

Males taken earlier were used as decoys, placed close to the flowers but were ignored by approaching males, which went directly to the flowers. Males were encountered as high as the 2,000-foot ridge toward the west, and as low as 50 feet above sea level near the foothills of Cleopatra's Needle at the north. There is forest and heavy lowland vegetation surrounding the island, showing that the birdwing is associated with woodland wherever it is found. Since there is not great variation in height of the ranges of the province from north to south, and the type of vegetation is about the same, it is likely that the range of this butterfly extends to either extremity. Perhaps some interesting subspecies may occur on the islands and islets which dot the northern and southern waters.

A NOTE ON *CARIA DOMITIANUS* AND *INO* (RIODINIDAE), WITH DESCRIPTION OF A NEW SUBSPECIES

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The *Caria* that flies commonly in southern Texas has been referred by most authors to the species *domitianus* Fabricius. Opinion has differed on whether the subspecies name should be *ino* Godman & Salvin or *melicerta* Schaus, there being a question of the distinctness of these two. Recently Mr. Roy O. Kendall, of San Antonio, Texas, asked me what the correct name of the Texas populations should be. Examination of available material has shown that the validity of the two subspecies was not the only point wanting clarification. The present paper summarizes the results of that examination.

In brief, two species are present rather than one: *domitianus* (from Guatemala south) and *ino* (from southern Mexico north). They are distinguishable in pattern, body color, wing shape and in male genitalia. Each has two known subspecies. Texas specimens should be known as *Caria ino melicerta* Schaus.

For information on the type of *melicerta* and on other material in the United States National Museum, I am grateful to Dr. Lee D. Miller, of the Catholic University of America, Washington, D. C. Records from the National Museum, provided by Dr. Miller, are indicated below by the abbreviation U.S.N.M.; records in Carnegie Museum by C.M. In the references TL stands for type locality. Descriptions below are coordinate and comparative, and mention little that is not a species or subspecies difference.

Caria domitianus

Male. Prothoracic legs and abdominal venter greyish. Forewing with pointed apex; upperside of forewing having a dark patch at cell-end with a smaller overlay of emerald green scaling, especially costally; hindwing with a thick, subterminal, emerald green line. Underside with ground evenly brick-red, apical and terminal areas not darkened on either wing; spot pattern faint or partly absent; no terminal blue line on either wing.

Female. Prothoracic legs and abdominal venter ochreous yellow. Forewing much less pointed than male. Hindwing below with subterminal and terminal spots fused together in each interspace below M_1, making a single series of much enlarged spots. Otherwise as described for male.

Male genitalia (Fig. 1, holotype of *d. vejento*, new subspecies). Phallus with portion distad of the bend shorter than portion proximad; frenum (heavily sclerotized strap linking proximal part of the phallus to base of valvae) with a hook-like distal process extending well beyond processus inferior of valva. Valva with processus superior broad and subquadrate, armed with two large, apical setae and three smaller, subapical setae, all peg-like, much thicker than ordinary setae.

The species occurs from Guatemala to northern South America. There are two subspecies.

CARIA DOMITIANUS DOMITIANUS (Fabricius)

Hesperia domitianus Fabricius, 1793, Ent. Syst. 3: 315 (TL "Guadeloupe" [probably incorrect]).

Symmachia galbula (Felder, 1861, Wein. Ent. Monatschr., 5: 99 (TL Prov. Caracas, Venezuela); Kirby, 1871, Syn. Cat. D. Lep.,: 313; Stichel, 1910, Gen. Ins., fasc. 112A,: 173 (with further references).

Symmachia domitianus: Kirby, 1871, Syn. Cat. D. Lep.,: 313.

Caria domitianus: Godman & Salvin, 1886, Biol. Centr.-Amer. Lep. Rhop., 1: 448; Stichel, 1910, Gen. Ins., fasc. 112A,: 173 (with further references); Seitz, 1917, *in* Seitz, Grossschmett. Erde 5,: 683, pl. 135 f; Holland, 1931, Butterfly Book (rev. ed.),: 217, pl. 76, figs. 1, 1a (specimen figured is from San Mateo, Costa Rica, in USNM).

Male. Ground color above rather pale; forewing with the patch of green scales large, occupying over half the dark patch; upperside discal spot pattern (spots in basal area; pm line elements) visible on both wings; underside spots faint, entirely absent in discal areas of both wings.

I have seen no females but Dr. Miller writes that they agree with the males in the above traits, except for absence of the green patch. On the underside females are more prominently spotted than males, and these spots are never completely absent, though they are little silvered.

Range. Costa Rica to northern South America.

Specimen records. COSTA RICA: San Mateo X, XI–II (CM; USNM); Esperanza VIII (USNM). COLOMBIA: Savaville (USNM); Santa Marta (Godman & Salvin, *l.c.*). VENEZUELA: Prov. Caracas (Felder, *l.c.*). Also in USNM, 1 ♂ "C. Allegre" [not located], 19.XI.1898.

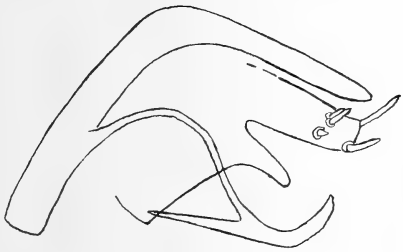
Caria domitianus vejento Clench, new subspecies

Caria domitianus ? (in part): Godman & Salvin, 1886, Biol. Centr. Amer. Lep. Rhop., 1: 448.

Differs from nominate *domitianus* as follows: Male larger; ground color of upperside darker, about as dark as *ino*; dark cell-end patch present, the superimposed green scales reduced in extent, covering less than half the dark patch; discal and basal spots of both wings faint, nearly absent. Underside with spots present uniformly over both wings. Female with blurred spot elements above on both wings; underside with all spots large, mostly quadrate, all prominently silvered except subterminal row on forewing below M_1, blackish.

Holotype, male (genitalia, slide C-1114), and paratype female: Guatemala, Zacapa, September, *leg.* W. Schaus; Carnegie Museum Ent. type series no. 511. Two male and three females from the same locality and collector (IV, VI) in the U.S.N.M. agree with the above diagnosis (*teste* L. D. Miller) but I have not seen them.

In addition there are in the U.S.N.M. a male from Cayuga, Guatemala, X, *leg.* Schaus, and a male "from L. Thiel, S. Sebastian, Retalhuleu," also Guatemala. Godman & Salvin (*l.c.*) record *domitianus* from Chontales, Honduras, quite possibly referring to this subspecies.



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Explanation of Figures

A portion of the male genitalia in *Caria*: the phallus with its frenum, and the outline of one valva. The proximal border of the latter is thin and poorly defined and is not shown. Fig. 1. *C. domitianus vejento* Clench, holotype ♂ (slide C-1114). Fig. 2. *C. ino melicerta* Schaus, ♂, Cameron Co., Texas (slide C-1111).

Caria ino

Male. Prothoracic legs and abdominal venter brick-red (apparently unique in the genus). Forewing with apex less pointed (*i.e.,* about as in *Calephelis*); upperside of forewing with no dark discal patch, almost no green scaling beyond a slender bar at cell-end, this bar silver or green; hindwing with subterminal green line thin or absent. Underside ground brick-red darkening to fuscous broadly along termen of forewing, less markedly on hindwing termen; spot pattern prominent, spots partly silvered; a terminal bluish metallic line on both wings.

Female. Prothoracic legs and abdominal venter ochreous yellow, not differing from female *domitianus*; forewing less pointed than male, not differing from *domitianus*. Hindwing below, with subterminal and terminal spot rows both present, not fused.

Male genitalia (Fig. 2, *ino melicerta*). Phallus with portion distad of the bend longer than portion proximad; frenum without a hook-like distal process, reaching only to base of processus inferior of valva. Valva with processus superior rounded-acuminate, slender, armed with thin, ordinary setae only.

Males differ from *domitianus* in the color of the fore legs and ventral surface of abdomen, in the darkened fuscous border of the forewing below, in wing shape and in male genital characters; females in the unfused subterminal and terminal spots of the hind wing below; and both sexes differ in the absence of the discal dark patch of the fore wing and the absence of the green scaling on it.

The distribution of *Caria ino* corresponds closely to that of the thorn forests in Mexico, at least where relevant information is available. Thorn forest formations occur in southern Texas, in much of Tamaulipas, in an isolated area of central Veracruz east of Jalapa (whence the type of *melicerta* came), and in northern Yucatan. *C. ino melicerta* occurs in all these areas. Thorn forests are also prevalent along the west coast of Mexico, such as at Mazatlán, where the type and many subsequent specimens of *ino* were taken.

CARIA INO INO Godman & Salvin, new status

Caria ino Godman & Salvin, 1886, Biol. Centr.-Amer. Lep. Rhop., 1: 449, pl. 43, figs. 22–25 (TL Ventanas [now Villa Corona], Durango, Mexico); 1901, *op. cit.*, 2(suppl.): 705; Holland, 1931, Butterfly Book (rev. ed.); 217, pl. 76, figs. 3, 3a (specimen figured, hardly recognizable, from Venadio, Sinaloa, in USNM).

Caria domitianus ino: Stichel, 1910, Gen. Ins., fasc. 112A: 174; Seitz, 1917, *in* Seitz, Grossschmett. Erde 5: 683; Hoffmann, 1940, An. Inst. Biol. Mex. 11: 697 (in part).

Male. Forewing with bar at cell-end leaden or dull silver; hindwing with cell-end bar and one or two costal spots of the pm series dull metallic (leaden) color; subterminal green line of hind-wing thin but distinct. Underside of hindwing with cell-end bar metallic, terminal line or spot row thick, the spots nearly contiguous.

There appear to be no useful discriminating characters in the female.

Range. Apparently confined to western Mexico, from the vicinity of Mazatlán south to Oaxaca.

Specimen records. SINALOA: Mazatlán 24–27.X.1961, 5♂ 1♀, *leg.* Cary-Carnegie Mus. Exp. (CM); Mazatlán, 1♂ (USNM); Venadio, 5♂ 1♀ (USNM). DURANGO: Ventanas [now Villa Corona] (Godman & Salvin 1886, *l.c.*). COLIMA: Colima, 1♀, *ex* Acad. Nat. Sci., Philadelphia. GUERRERO: Sierra de Guerrero 13.III, 1♀ (USNM); Venta de Zopilote (Godman & Salvin 1901, *l.c.*). OAXACA: no further data, 1♂ (USNM).

CARIA INO MELICERTA Schaus, new status

Caria melicerta Schaus, 1890, Entom. Americana, 6: 18 (TL, Paso de San Juan, Veracruz, Mexico); Godman & Salvin, 1901, Biol. Centr.-Amer. Lep. Rhop. 2 (suppl.): 705; Dyar, 1903, Bull. U. S. Natl. Mus., 52: 35 ("1902"); Holland, 1931, Butterfly Book (rev. ed.),: 217, pl. 76, figs. 2, 2a (hardly recognizable; specimen figured is the type).

Caria domitianus melicerta: Seitz, 1917, *in* Seitz, Grossschmett. Erde, 5: 683.

Caria domitianus ino: Stichel, 1910, Gen. Ins., fasc. 112A,: 174 (= *melicerta*); Barnes & McDunnough, 1917, Check List Lep. Bor. America,: 13; McDunnough, 1938, Mem. So. California Acad. Sci., 1: 23; Hoffmann 1940, An. Inst. Biol. Mex., 11: 697 (in part); dos Passos, 1964, Lep. Soc. Mem., 1: 50.

Caria domitianus (subspecies not specified): Klots, 1951, Field Guide to the Butterflies,: 125; Ehrlich, 1961, *in* Ehrlich & Ehrlich, How to know the Butterflies,: 247, fig. 488.

Male. Bar at end of forewing cell inclining to greenish; hindwing with no metallic scaling on cell-end bar or pm spots; subterminal line extremely thin, perhaps half as thick as in *i. ino*. Hindwing underside with cell-end bar fuscous, not metallic; terminal spot row thin, the spots discrete.

Female. No observed differences from nominate *ino*. Females divide readily into two types: (a) orange tinged above, terminal area little contrasting; (b) dark above, as dark as male, with a contrasting orange terminal area on both wings. (Form (a) is like the single female of nominate *ino* at hand).

Range. Southern Texas south to Yucatan.

Specimen records. TEXAS: Pharr, Hidalgo Co., 4.III.1945, 1♀, and 2.VIII.1945, 1♂, *leg.* H. A. Freeman; Cameron Co., 3.IV.1957, 6♂, *leg.* R. O. Kendall; San Patricio Co., 11.IX.1960, 4♂, *leg.* R. O. & C. A. Kendall, and 30.IX–7.X.1960, 7♀, *ex larva, leg.* R. O. Kendall. (All in CM). TAMAULIPAS: 1 mi. W. Soto La Marina, 100 m, 8.I.1966, 1♀ (Tamaulipan thorn forest), *leg.* H. K. Clench and L. D. Miller; no further data (Hoffmann, *l.c.*). VERACRUZ: Jalapa, 1♂ each in CM, USNM; Paso de San Juan, 6♂ 2♀, including type (USNM). YUCATAN: Chichén Itzá, 22,25.VIII.1954, 2♀, *leg.* E. C. Welling; Halacel, 8.IV.1954, 1♀, *leg.* E. C. Welling.

PALAEACRITA SPECIOSA HULST (GEOMETRIDAE) IN MINNESOTA

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On April 21 and 22, 1965 I collected a series of what I took to be *Palaeacrita vernata* Peck at a black light in Minneapolis, Hennepin County, Minnesota. In August 1965 I sent 30 individuals to Mr. Bryant Mather, Jackson, Mississippi, who, in turn, referred them to Dr. Frederick H. Rindge, of the American Museum of Natural History, New York. Dr. Rindge determined two of these to be *Palaeacrita speciosa* Hulst. In November 1965 I sent Mr. Mather the remaining 31 specimens and he also referred these to Dr. Rindge.

Dr. Rindge commented (in litt.) on the two specimens in the first group that he had determined as *P. speciosa* Hulst, as follows: "These are the first specimens I've seen of this outside of our type (from Colorado)!" One of the two specimens was retained by Dr. Rindge at the A.M.N.H., the other was returned to Mr. Mather and is now in his collection. Rindge (1955, p. 154) wrote of the Hulst type, in the A.M.N.H. collection: "*speciosa* Hulst, *Paleacrita* (1898, Canadian Ento., vol. 30, p. 113, Type male, Glenwood Springs, Colorado, 4-3-1893, W. Barnes)." In response to an inquiry as to the significance of the date "4-3," Dr. Rindge replied (in litt.): "The type specimen of this species is dated '4/3/1893' . . . this can be read as either April 3 or March 4 . . . in Hulst's original description he gives the date as May 3. This is obviously in error. I do not have any additional literature references on this species."

Dr. Rindge commented (in litt.) on the second group as follows: "I was very happy to see the nice series of *vernata* from Minneapolis. The amount of variability here has caused some problem at least as far as I am concerned. You will recall that earlier there were two specimens of what I called *speciosa*. The specimen that was retained agrees quite well with our type from Glenwood Springs, Colorado. Unfortunately, the type does not have an abdomen. In the series from Minnesota the specimens range from an almost immaculate gray to the variegated pattern of *speciosa*. This of course made me wonder just what was going on. I dissected the genitalia of the earlier '*speciosa*' and have just finished studying these structures. They agree perfectly with the normal *vernata*. So now the problem arises as to just what true *speciosa* might be. Unfortunately, I do not have any material in this immediate group from Glen-

wood Springs or anywhere else in Colorado. Forbes (1948) says that *vernata* goes west as far as that state.[1] At this point it looks like *speciosa* may either be a straight synonym of *vernata* or possibly a subspecies of it from the west. Pending the receipt of western material the problem cannot be answered."

In the original description, Hulst (1898) characterized *speciosa* by the whitish gray forewings, with five somewhat diffuse, black cross lines. The type has an expanse of 32 mm, and bears the data: Glenwood Springs, Colo., May 3; from Dr. Barnes.

It now appears that "*speciosa*-like" specimens occur not only in Colorado in March or April, but also in Minnesota in April. Additional records would be very desirable, especially from Colorado. This series of events emphasizes the desirability of the determination of specimens that could represent rare species yet resemble common ones checked by workers who are qualified to recognize such rare species.

The cooperation of Dr. Rindge, who determined the material and provided comments, and of Mr. Mather, who arranged to submit it for Dr. Rindge's study, passed the results on to me, and gave advice in the preparation of this article is very much appreciated.

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[1] *Palaeacrita vernata* is recorded from several western states by Essig (1926, *Insects of Western North America*) and from Colorado and California by Metcalfe *et al.* (1951, *Destructive and Useful Insects*). However, all specimens formerly under this name in the California Insect Survey, University of California, Berkeley, have recently been identified as *P. longiciliata* Hulst (1898) by Rindge, and the occurrence of *vernata* in the western states is in doubt. Prentice (1963, *Forest Lepidoptera of Canada*, Vol. 3) records localities west to Saskatchewan for *vernata*.—ED.

VARIATION IN *JUNONIA COENIA* IN MISSISSIPPI (NYMPHALIDAE)

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Concerning *Junonia coenia*, Klots (1951) wrote: "We do not yet fully understand the relationships of the various forms of this butterfly. . . . A great deal of careful study and thorough analytical work is needed." The present paper discusses results of a study of some aspects of variation in *Junonia coenia coenia* (Hübner) in Mississippi. The 105 Mississippi specimens which were studied were collected over a 10-year period, represented dates of capture in all 12 months and localities in 17 counties representing all sections of the state, and included 52 males and 53 females. Of the 105 specimens, 83 were taken in Hinds County and a total of 86 in the southwestern region of Mississippi as defined by Mather and Mather (1958), 12 were from the southeastern region, three from the northwestern, and two each from the northeastern and east central regions. No indication of intra-state geographical variation was detected. Features examined included: (a) Length of right forewing, measured with dividers and scaled to the nearest 1.0 mm; (b) Underside ground color (dark, intermediate, light); (c) Presence of subapical spot on forewing upperside as seen by the unaided eye (absent, faint, present); (d) Maximum diameter of each eyespot on the hindwing upperside, measured to the nearest 0.1 mm using an eyepiece micrometer and a magnification of 10 ×; and (e) Ratio of diameters and areas of the eyespots on the hindwing upperside. Data on each of these features are presented and discussed below.

Forewing length

The range of forewing lengths was 19 to 31 mm, distributed by month of capture as shown in Table 1; mean monthly values are indicated by open squares. The mean forewing length increases gradually from a minimum of about 21 mm in January to a maximum of about 27 mm in October, after which it decreases rapidly to about 24 mm in November and 22 mm in December. The peak in October and rapid decrease thereafter may coincide with the beginning of cold weather; the earliest date for killing frost in central Mississippi is October 10 and the average date is November 5.

In Virginia, Clark and Clark (1951) reported mean forewing lengths for the typical spring and fall form as 24 mm in males, 27 mm in females,

TABLE 1

DISTRIBUTION OF 105 SPECIMENS OF *J. C. COENIA* FROM MISSISSIPPI BY LENGTH OF FOREWING AND MONTH IN WHICH TAKEN, SHOWING SEASONAL CHANGE IN MEAN FOREWING LENGTH

NUMBER OF SPECIMENS

	FOREWING LENGTH, MM													
	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL
JAN	1	1	$\boxed{4}$	1		1								8
FEB		1	1	$\boxed{3}$										5
MAR	1		1	$\boxed{}$		1								3
APR			1	1	$\boxed{7}$	3	1	1						14
MAY		1				$\boxed{3}$	1							5
JUN				2		$\boxed{2}$	1							5
JUL					1		$\boxed{2}$							3
AUG	1					1	2	$\boxed{2}$	1					7
SEP					1	3	5	$\boxed{1}$	1	2				13
OCT					1		2	3	$\boxed{2}$	1	1	2	1	13
NOV		1		1	3	$\boxed{}$		1		1	1			8
DEC	2	2	5	$\boxed{6}$	1	1	2							21
TOTAL	5	6	12	14	15	15	15	10	4	4	2	2	1	105

$\boxed{}$ = MEAN FOREWING LENGTH OF SPECIMENS TAKEN IN INDICATED MONTH

and noted that summer specimens are a little larger and individuals of another form confined to localized wet areas are still larger, about 28 mm for males and 30 mm for females. Field (1940) reported size values for the Kansas population, normal range 45 to 50 mm, 60 mm for large females, and 35 mm for "dwarfs." Assuming that these may be converted to forewing lengths by subtracting 2 mm from each value for thorax width and dividing the remainder by two, the normal Kansas forewing length is 21.5 to 24 mm and the extremes are 16.5 and 29 mm. It would

TABLE 2

DISTRIBUTION OF 105 SPECIMENS OF *J. C. COENIA* FROM MISSISSIPPI BY DEPTH OF GROUND COLOR BELOW AND MONTH IN WHICH TAKEN, SHOWING SEASONAL CHANGE IN DEPTH OF GROUND COLOR UNDERSIDE

	DARK		INTERMEDIATE		LIGHT	
	No	%	No	%	No	%
JAN	7	88	1	12	-	-
FEB	5	100	-	-	-	-
MAR	2	66	1	33	-	-
APR	1	7	3	21	10	72
MAY	-	-	-	-	5	100
JUN	-	-	-	-	5	100
JUL	-	-	-	-	3	100
AUG	-	-	1	14	6	86
SEP	8	61	1	8	4	31
OCT	6	45	5	40	2	15
NOV	3	37	4	50	1	13
DEC	18	85	2	10	1	5
TOTAL	50		18		37	

therefore appear that the individuals comprising the Mississippi population are somewhat smaller in size than those of the Virginia population and very slightly larger than those of the Kansas population; and that our sample includes three specimens that are larger than the largest Field found and none as small as the smallest he found.

GROUND COLOR OF UNDERSIDE

The distribution of specimens by underside ground color and month of capture by number and percentage is shown in Table 2. No specimens with light ground color below were among those taken in January, February, or March; none with dark ground color below were among those taken in May, June, July, or August. The major seasonal shift from dark to light appears to take place between March and April, and

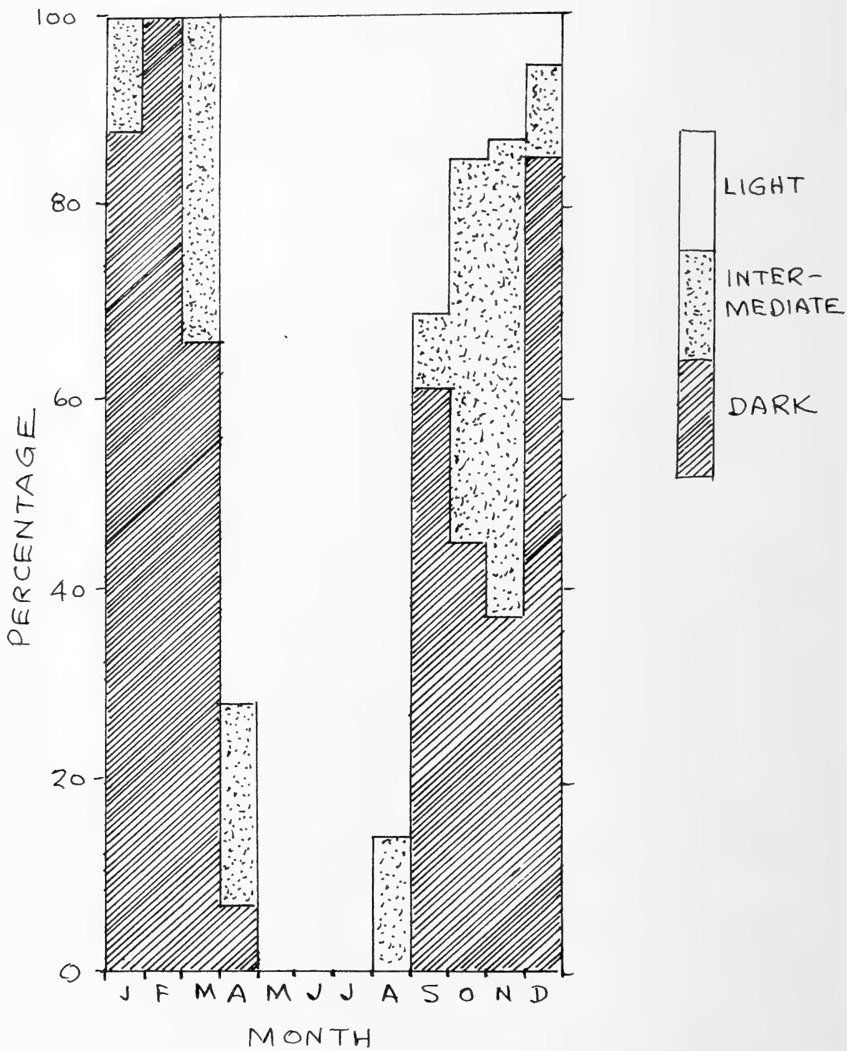

Fig. 1. Percentage distribution by months of capture of Mississippi specimens of *J. c. coenia* having light, intermediate, and dark ground color on underside.

from light to dark between August and September; the former being somewhat more abrupt than the latter. In central Mississippi the March–April shift coincides with a change in mean temperature from below 60° F to above 60° F (16° C), and the August–September shift with a change from above 80° F to below 80° F (27° C). The mean rainfall

for March is higher than for any other month (5.9 inches), and is lowest for October (2.5 inches). The August–September shift does not accompany an increase in average monthly rainfall; the mean values for August, September, and October being 4.0, 3.1, and 2.5 inches respectively. I have observed no association between depth of ground color below and moistness of habitat in Mississippi. The percentage relations of specimens of different depths of ground color below by months are shown in Figure 1.

Subapical spot on upperside of forewing

Of the 105 specimens examined, 53 were classified as having the spot well developed; in 40 it was present but faint; and in 12 it was not visible to the unaided eye. Examination of the latter at a magnification of 30 × revealed that at least a few blue scales were present or that the specimen was so rubbed that it might be assumed that such scales could once have been present. The twelve specimens showing no visible spot had forewing lengths from 19 to 29 mm, six had forewing lengths of 19, 20, or 21 mm; thus suggesting a tendency for obsolescence of this spot to be associated with diminution in size.

Relative size of spots of hindwing upperside

The measured values for the maximum diameters of anterior and posterior spots for the 105 specimens are plotted in Figure 2. Solid triangles represent males, open circles represent females. For each specimen represented by a spot in Figure 2 the ratio of the diameters of anterior to posterior spot was calculated and a frequency diagram of these ratios is given as Figure 3. Figure 3 indicates a skewed distribution. The most frequent ratio of diameters for the Mississippi population is about 1.65, with more specimens having values larger than this and fewer having smaller values. The diagram also suggests that the specimen having the smallest ratio (1.26), reported previously (Mather and Mather, 1958) as suggestive of the phenotype of *zonalis* is more clearly a part of the Mississippi population as a whole than the specimen at the other end of the distribution which has a ratio of 2.59. In Figure 4 the points representing the four Mississippi specimens yielding the extreme data points in Figure 2 are replotted and values derived from one additional specimen in our collection, nine specimens figured in the literature (see Table 3), are indicated. The three specimens figured by Holland (1931) and Klots (1951) that are assigned to *zonalis* have ratios between 1.15 and 1.29. The two Mississippi specimens with the lowest diameter ratios are 1.26 and 1.36. The position in Figure 4 of the points for the six figured specimens of *coenia* suggest that the individuals com-

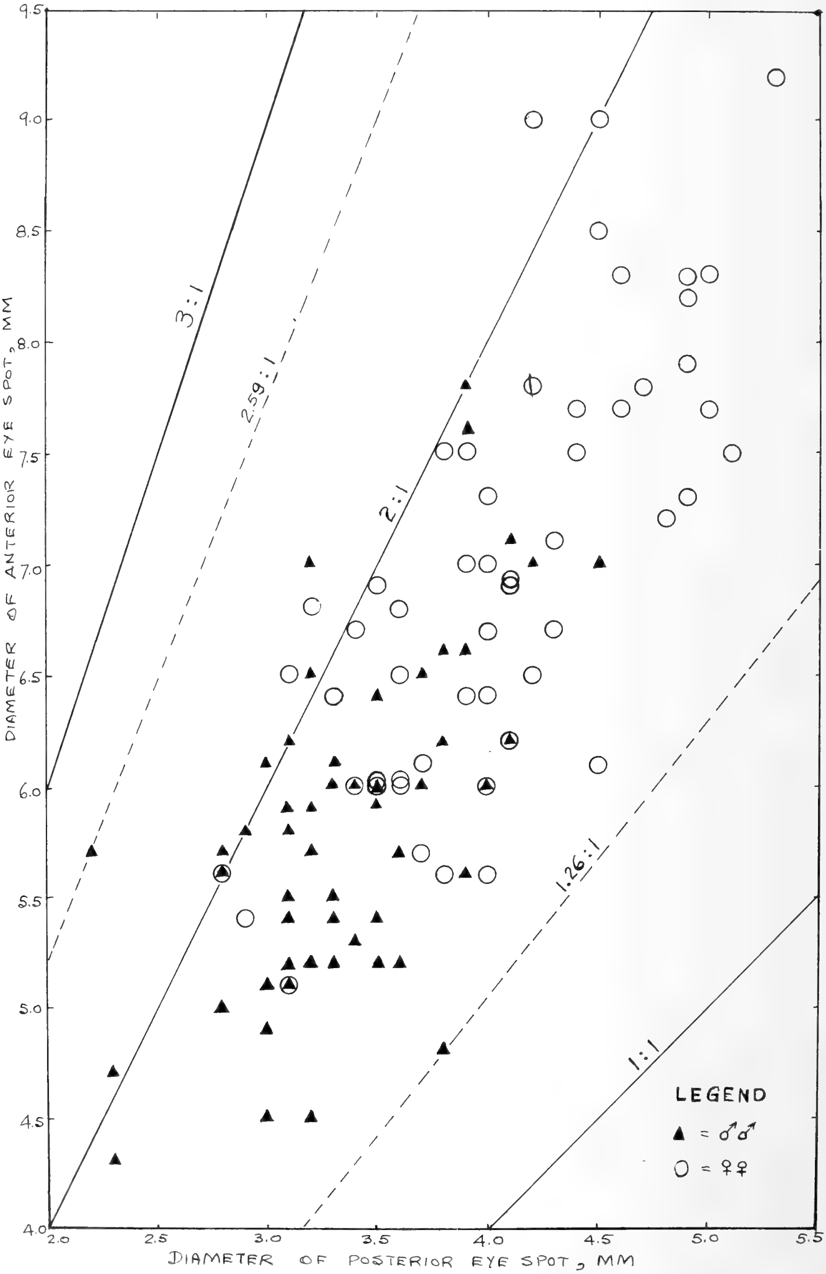

Fig. 2. Relation of maximum diameter of anterior and posterior eyespots on hindwing upperside for 52 male and 53 female specimens of *J. c. coenia* from Mississippi, showing extreme ratios of diameters of 1.26 : 1 and 2.59 : 1.

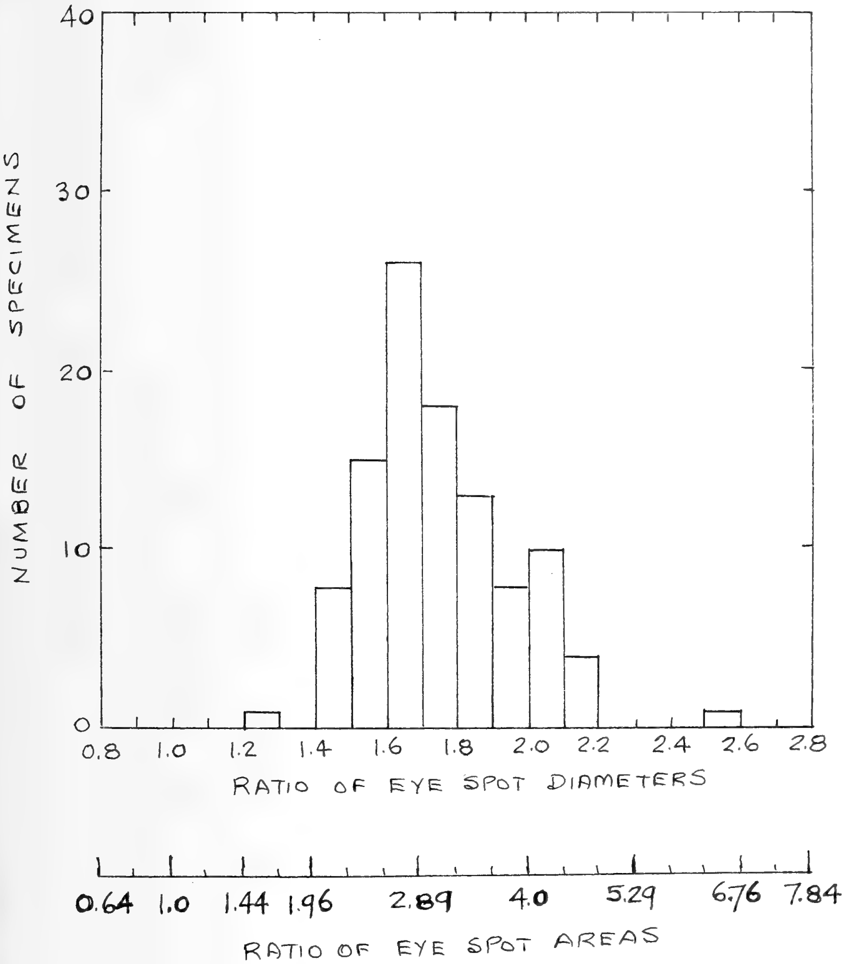

Fig. 3. Frequency distribution for ratios of diameters and ratios of areas of anterior and posterior eyespots on hindwing upperside for 105 specimens of *J. c. coenia* from Mississippi.

prising the Mississippi population may have ratios that are slightly lower than average for a "typical" *coenia* population.

Both Klots (1951) and Brown (1955) characterize *coenia* as having the anterior spot on the hindwing above "from two to three times as large as the posterior one" or "at least twice and often three times as large." This contrasts with *zonalis* in which the anterior spot is described as "little larger than the posterior one." Barnes and McDunnough (1916,

TABLE 3

RELATION OF MAXIMUM DIAMETER OF ANTERIOR AND POSTERIOR EYESPOTS ON HINDWING UPPERSIDE IN MISSISSIPPI *J. COENIA* AND SPECIMENS FIGURED IN THE LITERATURE AS *J. ZONALIS*. DATA PLOTTED IN FIGURE 4

	DIAMETER OF SPOT, MM		RATIO OF DIAMETERS	FORE-WING LENGTH, MM	DATE TAKEN	LOCALITY	REFERENCE
	ANTERIOR	POSTERIOR					
A	4.3	2.3	1.87	20	7 JUN 1959	CLINTON, MISS.	
B	4.8	3.8	1.26	25	10 SEP 1949	CLINTON, MISS.	MATHER AND MATHER (1958) "LIKE ZONALIS"
C	9.2	5.3	1.74	30	20 OCT 1957	BROWNSVILLE, MISS.	
D	9.3	4.5	2.07	29	22 SEP 1957	PETERSBURG, VA.	
E	5.7	2.2	2.59	19	8 AUG 1954	CLINTON, MISS.	
F	6.4	2.9	2.20	–	—	CHAPEL HILL, N.C.	KLOTS (1951), PL. 14, FIG 12 "COENIA" ♂
G	4.5	3.5	1.29	–	—	—	HOLLAND (1931), PL. XX, FIG 9 "GENOVEVA" ♂ (a)
H	4.4	3.4	1.29	–	—	TITUSVILLE, FLA.	KLOTS (1951), PL. 14, FIG 13 "ZONALIS" ♂
I	4.0	3.5	1.15	–	—	—	HOLLAND (1931), PL. XX, FIG 8 "LAVINIA" ♂ (a)
J	7.0	3.6	1.94	–	19 SEP 1925	CABIN JOHN, MD.	CLARK (1932), PL. 7, FIG 3 "COENIA" DRY FORM ♀
K	7.5	4.5	1.67	–	—	—	BROWN (1955), P 104 "LAVINIA f. COENIA"
L	8.5	4.6	1.85	–	25 SEP 1925	CABIN JOHN, MD.	CLARK AND CLARK (1951), PL. 5, FIG. 9 "COENIA" WET FORM ♀
M	9.0	5.0	1.80	–	—	—	HOLLAND (1931), PL XX, FIG 7 "COENIA" ♀
N	4.9	2.6	1.89	–	—	—	MACY AND SHEPARD (1941), PL. I "BUCKEYE" (COENIA)

(a) BOTH REFERABLE TO ZONALIS (KLOTS, 1951)

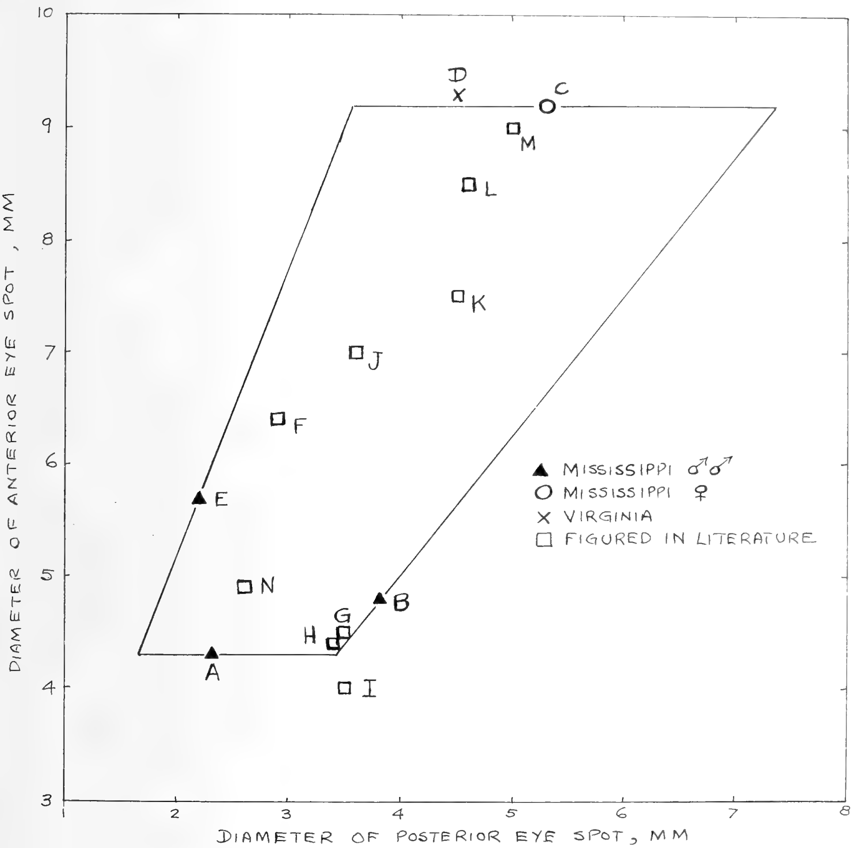

FIG. 4. Relation of maximum diameter of anterior and posterior eyespots on hindwing upperside for four Mississippi specimens of *J. c. coenia*, one from Virginia, six figured in the literature, and three specimens figured in the literature representing *J. zonalis*. Data for these fourteen points are given in Table 1.

Plate IX, Figs. 6, 7) figure a female *coenia* from Long Island, N. Y. and a female *genoveva* from Miami, Florida. The latter is similar to that figured by Klots (1951) from Titusville, Florida as *zonalis*. Barnes and McDunnough emphasize that the feature selected to differentiate *genoveva* from *coenia* was the replacement by orange suffusion in *genoveva* of the brownish encirclement bounded outwardly by the black of the large eyespot on the dorsal surface of the forewing in *coenia*. This difference is clearly shown in Klots' figure but not emphasized by him in the text. The Mississippi specimen (Fig. 5 B) having hindwing eyespots in the size relation of figured specimens assignable to *zonalis* does not

Fig. 5. Five Mississippi specimens of *J. c. coenia.* Specimens A, B, C, E yielded data shown in Figure 4; A has the smallest anterior spot of the sample; B has the

have the forewing eyespots surrounded by orange, but it also lacks a clear development of the blacker outer boundary of the brownish zone surrounding this spot.

The eyespots in the hindwing upperside in *coenia* are not exactly circular but were considered to be so for the calculation of areas from diameters. If two spots have the same diameter they were assumed to have the same area. In the absence of qualifying comment to the contrary I would assume that authors who describe a spot as "twice or three times as large" as another spot must refer to the area relations of the spots in question. For this reason, Figure 3 has been provided with two scales, one showing ratios of diameters, the other showing ratios of areas computed from the diameters. The range in ratios of diameters of spots of specimens yielding data plotted in Figure 4 is from 1.15 to 2.59, hence the range in areas ("sizes") is from about 1.3 to 6.9. The ratio of spot diameters of the figures of specimens of *coenia* given in Klots (1951) and Brown (1955) is respectively 2.20 and 1.67 which correspond to 4.8 and 2.8 in ratios of area. The most frequent diameter ratio for the specimens of the Mississippi sample is about 1.65 which corresponds to a ratio of areas ("sizes") of about 2.7. No reference has been found in the literature to a specimen of *coenia* having an anterior spot that has an area approximately seven times that of the posterior spot (Fig. 5 E).

Based on the data and the relations presented in Figures 2, 3, and 4, it is suggested that *zonalis* may be characterized in part as having hindwing eyespots above in which the diameter of the anterior spot is less than 1.4 times (or the area less than twice) that of the posterior spot; while *coenia* may be characterized, in part, by spots in which the diameter of the anterior spot is more than 1.4 times (or the area more than twice) that of the posterior spot and including individuals in which these ratios go up at least to 2.6 and 7 respectively.

Figure 5 is a photograph of five Mississippi specimens including those representing the observed extremes of variation in the dimensional relations of the eyespots in the hindwing upperside. Those designated A, B, C, and E define the limits of the observed data for the Mississippi sample as these limits are shown in Figure 4. In specimen B the larger spot is about one and one-half times as large as the smaller spot; in specimen E the larger spot is nearly seven times as large as the smaller; these two specimens account for the two bars in the graph (Fig. 3) that are separated from the mass of the data for Mississippi.

←

smallest ratio of diameters (1.26 : 1); C has the largest anterior and posterior spots; E has the largest ratio of diameters (2.59 : 1) and the smallest posterior spot; X has the smallest space between the anterior and posterior spots.

SUMMARY

The Mississippi population of *Junonia* represents a single variable population that may be called *Junonia coenia coenia* (Hübner). *J. c. coenia* is a population, the individuals of which characteristically have hindwing eyespots of such proportionate sizes that the diameter of the anterior spot is more than 1.4 times, and its area is more than twice, that of the posterior spot. All but two of 105 Mississippi specimens studied had hindwing spots with ratios of diameters of 1.4 or more. The Mississippi specimens have the hindwing spots of upperside somewhat more nearly equal in size than appears to be the case for *coenia* in the rest of its range. The Mississippi individuals range in size from those having a forewing as short as 19 mm to others having a forewing as long as 31 mm. The size increases from a January average minimum of about 21 mm to an October average maximum of 27 mm and then decreases rather rapidly. The ground color of underside is predominantly dark from September through March, and light from April through August. More individuals having light ground color persist after August than do individuals with dark ground color after March. No association of ground color of underside with moistness of habitat or variation of average rainfall was found. The change in depth of ground color of underside with season appears more abrupt than does the change of size with season. A majority of the Mississippi specimens showed a well-developed subapical spot in the forewing above; in most of the remaining specimens such a spot was visible but faint; in 12 of 105 specimens it was not visible to the unaided eye. An association of tendency for obsolescence of this spot with diminution of wing length was noted.

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EARLY STAGES OF *CHLOSYNE HOFFMANNI MANCHADA* (NYMPHALIDAE)

E. J. Newcomer
1509 Summitview, Yakima, Washington

Chlosyne hoffmanni manchada was described by Bauer (1959) from Chelan County, Washington. He also reported specimens from Okanogan County, north of Chelan County, and from Yakima County, to the south. This subspecies may also occur in Kittitas County, which is between Chelan and Yakima counties, and possibly in Klickitat County, south of Yakima County. Bauer also states that *manchada* may occur in British Columbia.

C. h. manchada is very common in Bear Canyon, about 25 miles west of Yakima (Newcomer, 1964). This colony has afforded the author a good opportunity to identify the foodplant. Apparently nothing has been published on the foodplants of *hoffmanni* or its subspecies, but related species are known to feed on *Castilleja* and *Aster*. Since the eggs are deposited in masses, oviposition by a female probably occurs but once or twice, and attempts to follow flower-visiting females to the foodplant failed. Eggs were obtained from captive females in 1962 and 1963, but the resulting larvae would not feed on *Castilleja* and only sparingly on China aster (*Callistophus chinensis* Nees, closely allied to *Aster*) and on michaelmas daisy (*Aster novae-angliae* L.).

Finally, in late summer of 1964, *Aster conspicuus* Lindley was discovered in Bear Canyon. This is a large plant growing to a height of 30–60 cm with leaves often 15 cm long. It usually occurs in light shade under pine trees, where it may bloom very sparingly. For this reason I had overlooked it. Examination of two large clumps of this aster late in July revealed small, spiny caterpillars feeding gregariously on the foliage. These proved to be larvae of *C. h. manchada*. Most were in the second and third instars. They had spun some webbing over the leaves and were feeding underneath the web in groups, side by side, advancing across the leaf and skeletonizing it. Many leaves had been completely skeletonized in this manner and most of them had curled up. Often caterpillars were found in these curled leaves. The remains of egg masses were found on the undersides of the leaves.

Caterpillars brought into the laboratory fed for a time but soon showed a tendency to congregate in the curled leaves and do no more feeding. It was evident that they were going to hibernate in this partly grown condition. Attempts to bring them through the winter were not successful.

The aster plants die down in the fall and new growth comes up in the spring. The location of these plants was marked and first attempts to find them in the spring were on April 20, when there was still some snow in the canyon. By May 10, growth of the plants was noticeable and a few larvae were found. On May 18, larvae were fairly plentiful, feeding individually. They were then in the 4th and 5th instars. There had evidently been considerable winter mortality. A temperature of –19° F. had been recorded by the Weather Bureau near that area on December 17, but at that time there were about 10 inches of snow on the ground. This should have protected most of the caterpillars.

Some of the caterpillars were brought into the laboratory where they began pupating on May 19. Emergence of most of the butterflies took place between May 28–31. It was no doubt hastened by the room temperature, as no adults were seen in Bear Canyon until June 4. They continued to fly until July 6, and in other years have been seen there as late as the end of July.

Oviposition was observed June 23, when a female was flushed from a clump of asters. She soon settled down again, crawled to the underside of a leaf, and deposited 30 eggs during the next seven minutes. The leaf she had flown from was then examined and a cluster of 82 eggs was found which she had apparently just deposited. Many other egg clusters were present and the eggs in 12 of these were counted. They ranged from 25 to 179 per cluster, and averaged 72. Evidently a single female is capable of depositing about 200 eggs.

Some of these eggs hatched June 30 and the caterpillars went into diapause July 17. The eggs deposited June 23 hatched July 2 and these caterpillars were still feeding July 18, when I went away for a week. On my return most of them were alive and quiescent and would do no further feeding.

Thus, at room temperature, the egg stage lasted about nine days, larval feeding in the fall lasted two to three weeks, there was another feeding period in the spring of perhaps two weeks, and the pupal period was a week or ten days.

Abrams and Ferris (1960) give the range of *Aster conspicuus* as "British Columbia south through eastern Washington to northeastern Oregon and east to Saskatchewan, Wyoming and South Dakota." It does not occur in the Oregon Cascade Mountains but only in the Blue Mountains in the northeastern part of Oregon. In 1965 I examined a number of localities where *manchada* has been taken and found *Aster conspicuus* in every one. It does not follow, however, that the range of *manchada* is the same as that of *conspicuus*, but, unless *manchada* has

other foodplants, its range must be within that of the aster. Bauer (1959) has suggested that the Columbia River Gorge, between Washington and Oregon, may have sufficiently isolated the *hoffmanni* population north of the Gorge so that it became differentiated. It might also be suggested that the different foodplant has had some influence, since *segregata* in Oregon and *hoffmanni* in California must feed on asters other than *conspicuus*.

Description of early stages

Ova.—Width 0.6 mm, light green, fluted; deposited in masses, somewhat overlapping.

Larvae.—First instar: Head width 0.4 mm, black with many small setae. Body length 1.5 mm, light cream with many long setae.

Second instar: Head width 0.6 mm, black. Body length 2.25 mm, gray, shiny, some lighter markings, many setae. Cervical shield black with six black spines. Thoracic segment I with a lateral tubercle bearing several spines; segments II and III with dorsolateral and lateral spine-bearing tubercles; abdominal segments 1–8 with seven tubercles each, one dorsal and the others lateral, arranged transversely; segment 9 with two dorsal tubercles and only two small lateral ones, each with a large terminal spine and several smaller ones; anal segment with two large dorsolateral tubercles. Thoracic legs dark brown, abdominal prolegs concolorous.

Third instar: Head width 1.0 mm, black, somewhat cleft, with numerous black setae. Body length 6–8 mm, dark gray above, lighter below; a narrow, darker dorsal stripe and a wider dark dorsolateral stripe. Dorsolateral tubercles black, lateral light yellow.

Fourth instar: Head width 1.5 mm, color as in preceding instar. Body length 10–15 mm, color as in preceding instar.

Fifth instar: Head width 2.0 mm, black, cleft, with setae as before. Body length 16–19 mm, as much as 25 mm when fully fed; color black above with numerous whitish dots; tubercles and spines located as before, those above lateral line black, circled with white. A cream-colored scalloped line just above the spiracles; color below that and on venter brownish, tubercles here brown. Thoracic legs black.

Pupae.—Length 11–13 mm, width at thorax 5 mm; shape typical of Melitaeinae. Basic color pearly white to brownish with many irregularly shaped brown to blackish markings.

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GEORG PRONIN (1898–1962)

Georg Pronin, a member of the Lepidopterists' Society, died in San Francisco, October 30, 1962, of cancer. He is survived by his wife, a son in Washington, D.C., a brother, and his stepmother, Mrs. Aleksandra Pronin of Beverly Hills, Calif.[1] Georg was a forest engineer by training and a naturalist by avocation, interested in butterflies and moths above all else. Fluent in Russian, Polish, Czech and German, he arrived in the United States in 1951 without a word of English. In less than a year he was writing articles which needed considerable rewording yet were basically lucid.

He was a religious man, one who in honesty prayed for his enemies. They must have seemed legion, for Georg lived through a troubled period of European history. Despite hardships, disappointments, and more than once the loss of virtually all his possessions, he was sustained by his faith that all was ordained, and his belief that tomorrow would be better. His optimism was joined to a fruitful imagination. Indeed in his later years his hopeful castles in the sky kept him cheerful with but a minimum of worldly goods.

Born in Kashin in the Tver (now Kalinin) region of Russia on December 28, 1898, he was, on his mother's side, grandson of a naval officer, hero of the defence of Sebastopol. His father was President of the Kharkov District Court of Imperial Russia, and widely known as a very just man. Georg attended high school in Kharkov, graduating in 1917 with a gold medal. He then entered the Officer Military Academy of Engineers in Petrograd (St. Petersburg).

He fought for the Russian Provisory Government, was captured by the Bolsheviks, put in Petropavlosk fortress prison, and sentenced to be shot. With others he was standing before the firing squad when the lady Peshkova, wife of M. Gorky, came by and glanced at the list of condemned. "Who is Pronin?" Georg answered. "Is it your father who was Assistant Prosecutor in Nizhny Novgorod?" "Yes." "You are free. Give my regards to your father; I always remember him with gratitude." Georg asked that the others be freed; the wish was granted and the shooting cancelled.

After his liberation he entered the Biological College of Kharkov University. In January, 1919 he joined the Voluntary (White) Army of General Denikin, serving during the Russian Civil War in the crew of the armored train "Officer," and suffering a concussion of the brain. He was evacuated to Constantinople in the autumn of 1920. After some

[1] To the last I am indebted for much of the information in this obituary; and to Peter Rubtzoff for translations from the Russian.

wandering in Turkey, General Kutepov helped him and others to reach Czechoslovakia in 1921. There he attended the College of Forestry of the University of Prague, graduating in 1927 with the degree of Forest Engineer. Between 1925 and 1927 he worked part time in the entomological museum of the Biology Department of Charles University.

In Prague Georg married Zinaida Uspensky, daughter of a doctor from Kharkov, and after his graduation they moved to Poland. He was employed by the Province of Wolhynia, organizing and directing an entomological station near Lutzk, and teaching biology in the high school of that town. During the German occupation of World War II he worked as an entomologist near Lodz. In 1945, with his wife and son, he traveled to the American Zone of Germany, where they were held in a displaced persons camp.

In the United States he came almost directly to San Francisco and for a time worked for the Entomology Department of The California Academy of Sciences, then for Robert Wind at Pacific Grove. Through the generosity of Dr. Ralph Hall he spent the summers of 1951–52 in northern California at the Hat Creek entomological station of the United States Forest Service. During part of 1953 he was employed by the Oregon State Board of Forestry at Salem.

Georg was observant, imaginative and, as he liked to say, a "fanatic" entomologist. In his work in Poland he used two of his own inventions with great success. He built a large trap with glass baffles, baited it with, among other things, fermenting exudate from trees attacked by cossids, and by rope and pulley set it high in the trees. His "Turgorator," for keeping cut branches fresh by the week, even in cages in full sunlight, was described and illustrated in an article in *The Lepidopterists' News*. Working independently he came to an understanding of diapause in Lepidoptera and found out how to break it in many species.

As a result of the above, he was able to obtain in numbers species thought to be very rare; to bring the larvae to maturity in a shorter time than in nature because of hydrostatic pressure maintained in the food by the Turgorator; and to rear several generations of otherwise univoltine species, including species which would mate in cages only if in sunshine. He did not keep a personal collection, but gave reared specimens away or traded them for equipment or ova of interesting species. He was an excellent preparator of Lepidoptera. He had ability as a photographer, and skill in making freehand drawings of insects.

Unfortunately Georg Pronin did not keep a record of his publications in European journals; he is said to have papers in Austrian and German serials. His large manuscript on diapause was sent to a publisher in

Germany about 1959, but was not issued because of a lack of finances.

Non-entomological published writings include a booklet of poetry, and his experiences in the armored train "Officer."

RECENT PAPERS BY G. PRONIN

1952. Suggestions for preventing outbreaks of bark beetles in California pine forests. Pan-Pacific Ent., 28(4): 186–188.

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—HUGH B. LEECH, *California Academy of Sciences, San Francisco.*

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE ANNOUNCEMENT A.(n.s.)76

Required six-months' public notice is given on the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names, listed by Case Number (see *Bull. zool. Nomencl.* 23, pt.5, 20 December 1966):

1761. Type-species for *Patanga* Uvarov, 1923; Neotypes for *Acridium assectator* Fischer von Waldheim, 1833, and *Gryllus succinctus* Linnaeus, 1763 (Insecta, Orthoptera).

1763. Type-species for *Proteinus* Latreille, 1796 (Insecta, Coleoptera).

1764. Suppression of *Musca lateralis* Linnaeus, 1758 (Insecta, Diptera).

1768. Type-species for *Thrix* Doherty, 1891 (Insecta, Lepidoptera)

Comments should be sent in duplicate, citing Case Number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W.7, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature*.—W. E. CHINA, *Assistant Secretary.*

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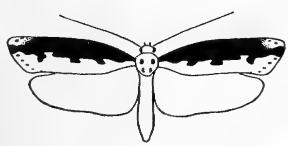

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LEPIDOPTERA OF THE CENTRAL BRAZIL PLATEAU. I. PRELIMINARY LIST OF RHOPALOCERA: INTRODUCTION, NYMPHALIDAE, LIBYTHEIDAE

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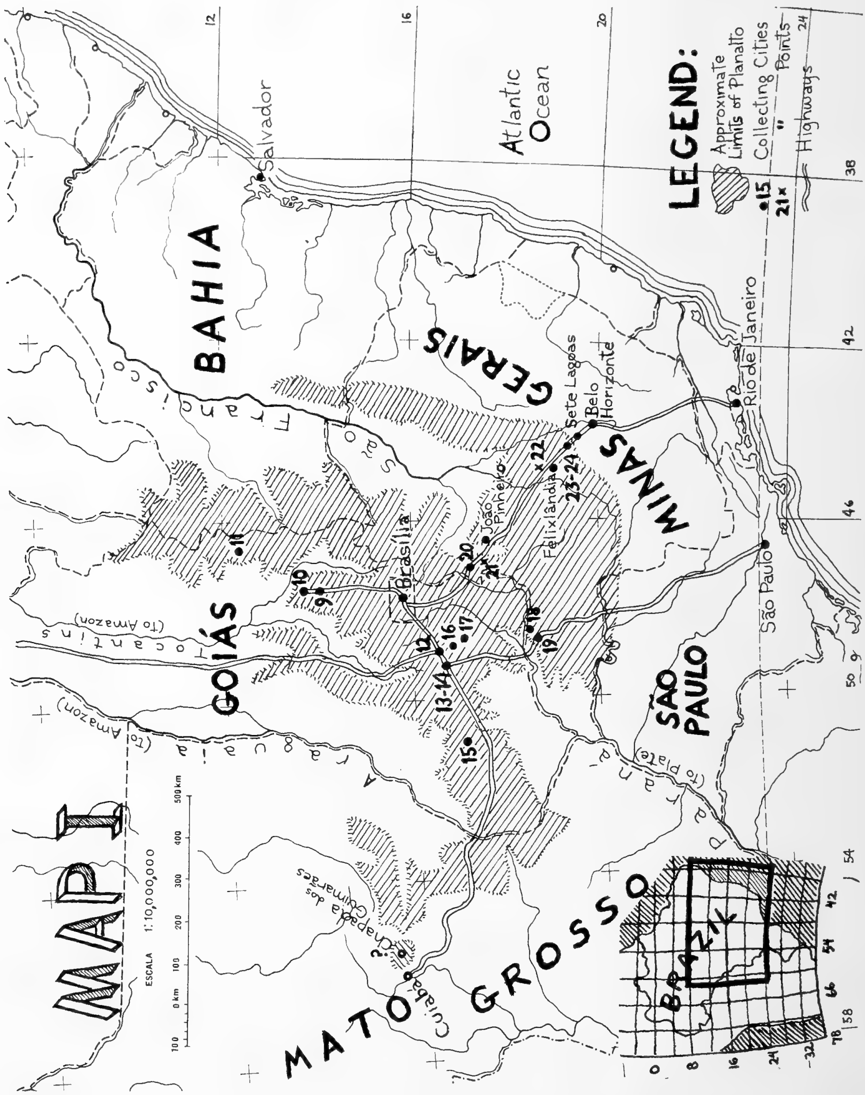
The insect fauna of the central plateau (*planalto central*) of Brazil is so poorly known that most published species distribution maps simply leave the entire area blank. For example, *Heliconius erato phyllis*, the most generally distributed butterfly of the area, does not seem to be known from the planalto in the majority of the major world museums (see Emsley, 1964). Spitz collected a great deal in the area in the 1930's and deposited much of the material in Germany and Austria, but only very brief publications have resulted from this, dealing with certain new species and some general aspects (Spitz, 1930, 1931a, 1931b; Seitz, 1930–1932).

There has been considerable material published concerning species collected by Herbert H. Smith in the 1890's at Chapada, Mato Grosso. We presume that this is Chapada dos Guimarães, about 30 miles east of Cuiabá at about 750 meters elevation. However, much of the material reported from "Chapada" may have been collected at lower elevations in Mato Grosso, for it is more typical of the pantanal or the Amazon drainage of the state than the cerrado portion. There are also several other Chapadas in the state of Mato Grosso, and we have not succeeded in discovering with certainty at which one Mr. Smith made his collections.

Even Chapada dos Guimarães presents some questions in relation to inclusion in the present list. It is separated from the large body of the Mato Grosso-Goiás cerrado by a considerable area of less than 600 meters elevation. A list of Rhopalocera for the settlement of Buriti, elev. 700



EXPLANATION OF MAP I

Portion of south central Brazil, showing approximate extent of the central plateau, or planalto, and indicating collection localities.

meters and on the Chapada dos Guimarães near the town of Chapada (Talbot, 1928) shows 35 species not on the present list. Of these, 11 are mentioned herein as expected to be added to this list; while 12 are Amazonian and have not been noted by us for any other areas of the planalto.

Thus, we regard the Chapada dos Guimarães, which may or not be the "Chapada" of the literature, as a northwestern blend zone of the cerrado fauna with the upper Amazonian/Bolivian fauna, and exclude it from our consideration.

In order to begin to understand the Lepidoptera of this "savanna" area, we made several excursions totalling four weeks in midsummer, early winter, and late winter into the heart of the area, the new Distrito Federal encompassing the capital, Brasília. The region covers much of the states of Goiás (formerly spelled Goyaz, and generally still published thus in the literature) and Minas Gerais and parts of São Paulo, Mato Grosso and Bahia (see Map I). We have also collected data from other collections, including those of Messrs. Paulo Gagarin (Rio), Nirton Tangerini (Rio), and Romualdo Ferreira d'Almeida (Rio). We have catalogued material in the large collections of the Museu Nacional (Rio), the Instituto Oswaldo Cruz (Rio; in care of Dr. Hugo Souza Lopes, who has also collected considerably in the planalto), and the part of the Spitz collection included in the Departamento de Zoologia (São Paulo; in care of Dr. Lauro P. Travassos Filho). We have determined the majority of this material (with the notable exceptions of "*Euptychia*" and certain Theclinae) and present here a preliminary list of Rhopalocera, along with comments on the species, distributional and seasonal data, and broad relationships of the fauna to neighboring faunal regions of Brazil. Future papers will deal with Heterocera, Rhopalocera forms as yet unidentified and records accumulated later, and the fauna of the "blend zone" at the southern limit of the region, as well as further studies as they may present themselves.[1]

The Area

The planalto central is roughly crescent-shaped (see Map I) and is approximately centered on the new capital Brasília. It comprises nearly 650,000 square kilometers and lies at an altitude of 600–1300 meters, between the Amazon basin to the north and west, the River Plate basin to the southwest, the São Francisco River basin to the northeast, and the Serra do Mar mountain ranges to the southeast. The region is characterized by strongly marked wet (October–March) and dry (April–

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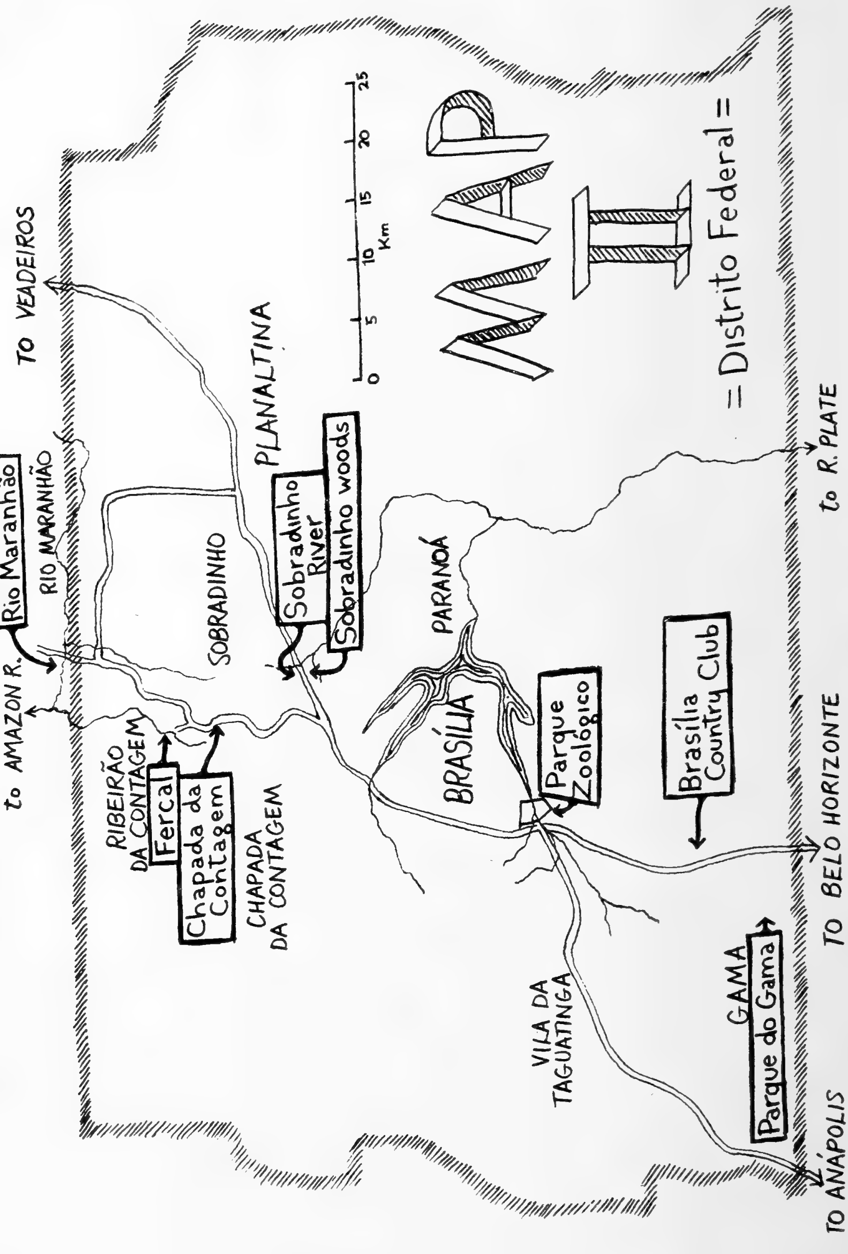
[1] We invite collectors or curators possessing specimens from known localities within the area to communicate with us, so that we may compile this data for future supplements to this list.



Explanation of Map II

Detail sketch map of vicinity of Brasilia, showing collection localities in the Distrito Federal.

September) seasons. Despite generally poor soil ("cerrado," resembling the North American Great Basin), a large number of plant species occurs here, with interspersed wooded swamps and dry deciduous woodlands. The latter contain the majority of the Lepidoptera. Few true mountains are present, although some steep areas are encountered, particularly in major watersheds. Most watercourses flow the year around. The three major river systems bordering the area originate in the vicinity of Brasília to produce striking vegetation contrasts in a relatively small area. Information on the vegetation of the planalto is best obtained in the papers presented to the Sociedade Botânica do Brasil; this information has been summarized recently (Heringer, 1966).

We have set the borders of the planalto at 600 meters elevation from the northeast around through northwest to the southwest, where the planalto is bordered by river systems. At the southeastern edge of the area, the flora and fauna of the planalto blend over a rather narrow zone into the more varied flora and fauna of the Serra do Mar, the southeast coastal mountain area of Brazil, without dramatic changes in elevation. We have drawn our limit on the Belo Horizonte-Brasília highway just southeast of Paraopeba, Minas Gerais, where the forest fauna shows fewer than half a dozen butterfly species characteristic of the Serra do Mar and not found further north over the majority of the planalto. Thirty kilometers south (Sete Lagoas) or east (Serra do Cipó) of Paraopeba, the terrain becomes more mountainous and forested, the cerrado of red soil is replaced by open grassland of richer brown soil, and a day's collection will produce dozens of species not known from localities within our area of concern. We have drawn the boundary more approximately in other areas, using terrain maps as a guide.

Collecting Localities

The following list includes material from 25 localities, in addition to some isolated records from other points. These areas are designated on the accompanying Maps. The localities and abbreviations as used on the list are as follows (localities 1–8 are shown on Map II, nos. 9–24 on Map I).

1. Sobradinho River (*SobrdR*) = Creek crossing BR-020 just southwest of Sobradinho, Distrito Federal; swampy woods along northwest side of highway. Elevation 1025 m; drainage River Plate.
2. Sobradinho Woods (*SobrdW*) = Dry woods and adjoining cerrado along southeast side of highway, above and southwest of Sobradinho River valley (Córrego Capão Grande). Elevation 1050–1150 m; drainage River Plate. By far the richest of all the areas collected by the authors.

Fig. 1. Heavy, moist woods (e.g., Paraopeba, Minas Gerais); lower elevations, 600–900 m. Typical Lepidoptera: Satyrinae, especially *Taygetis*, Ithomiinae, *Heliconius*, bait-attracted Nymphalinae, *Morpho*, *Paridas*, many characteristic Riodininae and skippers.

3. Chapada da Contagem (*Contagem*) = Dry woods on dirt road to rock quarry (Fercal) north of Brasília, Distrito Federal (on Chapada da Contagem, 21 airline kilometers due north of the Rodoviária in Brasília). Elevation 900 m; drainage Amazon River.

4. *Fercal* = Ribeirão da Contagem below rock quarry (known as Fercal) at the end of above dirt road, 24 km north of the Rodoviária; heavy steep woods, wide river with sand bars and cliffs. Elevation 840 m; drainage Amazon River.

5. Rio Maranhão (*Maranhão*) = Upper Rio Maranhão, where crossed by dirt road with high bridge, 30 km north of the Palácio da Alvorada, Brasília; open woods, riverside forest (*mata ciliar*), dense, moist forest, sand bars, Amazon-type upland open woods (*caatinga*). Probably just inside Goiás. Elevation 700 m; drainage Amazon River.

6. Jardim Zoológico (*JZool*) = Parque (Jardim) Zoológico de Brasília (forest, swamps, marshes, fields at southwest tip of lake). Elevation 1020 m; drainage River Plate.

7. Brasília Country Club (*BrasCC*) = Woods behind Catetinho and lying almost wholly within the property of the Brasília Country Club,

Fig. 2. Sparse, moist woods (e.g., Parque Zoologica, Brasilia); swampy and common near watercourses. Typical Lepidoptera: Ithomiinae in great numbers, *Heliconius, Dynamine, Hamadryas, Catonephele, Anaea,* some Riodininae, and many skippers.

by BR-040 just south of Brasília; also adjacent cerrado and marshes. Elevation 1200 m; drainage River Plate.

8. Parque do Gama (*PGama*) = Municipal park of the satellite city of Gama, Distrito Federal; heavy steep forest above rushing stream. Elevation 1100 m; drainage River Plate.

9. Chapada dos Veadeiros (*Vead*) = town and vicinity of Veadeiros, Goiás. Elevation 1000 m; drainage Amazon River; exact localities and dates of specimens not known.

10. Cavalcante (*Cav*) = town of Cavalcante, central Goiás. Elevation 900 m; drainage Amazon River; exact localities and dates of specimens not known.

11. Taguatinga (*Tag*) = Town of Taguatinga (Santa Maria de Taguatinga), east-central Goiás. (Not the satellite city of present-day Brasília known as "vila de Taguatinga"). Elevation 700–800 m; drainage Amazon River; exact localities and dates of specimens not known.

12. Anápolis (*Anap*) = City of Anápolis, south-central Goiás, and environs. Elevation 1000 m; drainage River Plate; exact localities not known, but most dates specified.

Fig. 3. Front of a dry, deciduous upland woods around a *cabeceira* or "water-head" (e.g., Brasilia Country Club); occurring in all parts of the planalto, especially at higher elevations and along fast-flowing streams. Typical Lepidoptera: *Pareuptychia, Taygetis, Heliconius, Morpho, Agrias, Tigridia,* and other bait-attracted Nymphalinae, *Mesosemia* and many other characteristic Riodininae, Dismorphiinae, and many skippers. In general the richest faunal habitat in the planalto.

13. Goiânia (*Goiânia*) = city of Goiânia, south-central Goiás. Elevation 800 m; drainage River Plate. Exact localities known in some cases (Hôrto Florestal, Vila Nova Brasília, Santa Genoveva), dates usually known.

14. Campinas (*Camp*) = suburb of present-day Goiânia once a separate city, called Campinas. Elevation 800 m; drainage River Plate; exact localities not known.

15. Fazenda Rio Claro (*RClaro*) = Fazenda Rio Claro on the Rio Claro, west Goiás. Elevation 850 m; drainage River Plate.

16. Leopoldo Bulhões (*Leop*) = town of Leopoldo Bulhões, south Goiás. Elevation 1000 m; drainage River Plate; exact collecting localities for specimens not known.

17. Vianópolis (*Vian*) = town on Vianópolis, south Goiás. Elevation 1000 m; drainage River Plate; exact localities unknown.

18. Araguary (*Arag*) = town of Araguary, in the triangle area of Minas Gerais. Elevation 650 m; drainage River Plate; exact collecting localities not known.

Fig. 4. Typical cerrado (e.g., Brasilia Country Club); covers the vast majority of the planalto. A depauperate but characteristic Lepidoptera fauna: endemic Satyrinae, *Phyciodes pedorna, Hamadryas, Evonyme bechina, Libythina cuvieri, Callicore sorana*, many endemic Theclini, a few endemic Riodininae, *Papilio thoas, Phoebis*, and many skippers.

19. Uberlândia (*Uberl*) = city of Uberlândia, in the Minas Gerais triangle just south of Araguary. Elevation 800 m; drainage River Plate; exact collecting localities unknown.
20. Paracatú (*Parac*) = town of Paracatú, N. Minas Gerais. Exact locality not known, but probably close to following.
21. Kilometer 485 (*K485*) = woods along stream west of BR-040 (Belo Horizonte-Brasília) Km. 482–488, município Paracatú, Minas Gerais. Elevation 600 m; drainage São Francisco River.
22. Kilometer 222 (*K222*) = Swampy woods and cerrado along BR-040, Km. 222, município Felixlândia, Minas Gerais. Elevation (estimated) 700 m; drainage São Francisco River.
23. Paraopeba Estação Florestal de Experimentação (*PPEflex*) = original Hôrto Florestal, Ministry of Agriculture, Paraopeba, Minas Gerais. (Km. 116 of BR-040, Belo Horizonte-Brasília). Typical cerrado with a little riparian forest. Elevation 740 m; drainage São Francisco River.
24. Paraopeba Woods (*PPW*) = Heavy moist forest 3 Km. east of BR-040 in Paraopeba. Elevation 750 m; drainage São Francisco River.

25. "Goyaz" (*Go*) = state of Goiás in general, locality unknown. Mostly collected in 1926 and possibly near Goiânia.

In addition to locality as above, each species includes date(s) and abundance. Abundance is represented either by actual numbers caught of each sex, or seen and positively identified at close range (coded *s*), or by common (*c*, 10–50 seen in an average day's collecting) or abundant (*a*, over 50 seen in an average day).

Nomenclature

The nomenclature of even the best known groups of South American Lepidoptera is still in flux. Therefore, we have used the most recent and authoritative work of which we are aware for each species or group. A large percentage of the identifications were made by R. F. d'Almeida of Rio de Janeiro; many others have been made by the authors, sometimes from the original literature. We have tried to designate sources by appropriate bibliography, and have also added personal interpretations in cases of controversy. We strive only for clarity and do not pretend to make a synonymic list.

Location of Specimens

Unless otherwise indicated on the list (by appropriate initials as below) all recent material from localities within the Distrito Federal (1 to 8), Km. 485 and 222 (localities 21, 22) and Paraopeba (23, 24) is in the authors' collections (if only one or two specimens are available, initials KB or OM indicate location; Hesperiids, unless otherwise initialed, are with O.M.); material from the Jardim Zoológico (6) before 1965 and all specimens from Goiânia (13) and Rio Claro (15) with Mr. Tangerini (NT); all material from Veadeiros (9), Cavalcante (10), Taguatinga (11), Anápolis (12) and "Goyaz" (25) in the Museu Nacional, Rio (MN); all specimens from Uberlândia (19) and Paracatú (20) in the Instituto Oswaldo Cruz, Rio (OC); and all material from Campinas (14), Leopoldo Bulhões (16), Vianópolis (17) and Araguary (18) in the Departamento de Zoologia, São Paulo (DZ). Material from various localities in the collection of Mr. Paulo Gagarin is designated by (PG).

Faunal Relationships

The following list clarifies the intermediate position of the planalto with relation to the much better known faunae of the Amazon Basin to the north, and the Serra do Mar of southeast Brazil. Many of the species occurring on the planalto are widespread, occurring in both of the above areas and generally in most of Latin America. Subspecies usually tend

toward the more southern form, although a fair number are intermediate between the latter and the Amazonian form, helping to demonstrate the complete cline which may exist between named and quite different forms from northern and southern Brazil. In other cases, a real separation exists within the planalto, the northern form barely reaching the northern edge of the planalto, the southern form not passing the blend zone on the southern margin. A few endemic forms are present, but essentially all of these also occur in the "blend zone" to the south of the region and even well into the Serra do Mar, or else considerably northwestward into the Amazon drainage and pantanal of Mato Grosso.

The following are the species and subspecies which may be regarded as most characteristic of the planalto, those which do not range widely outside the area: *Cercyonis luederwaldti, Hypoleria emyra, H. goiana, H. proxima consimilis, Pseudoscada quadrifasciata, Phyciodes pedrona pedrona, Catacore kolyma connectens, Diaethria eluina, Evonyme bechina, E. volumna intricata, Hamadryas chloe rhea, Agrias claudia godmani, Hamearis colchis, H. middletoni, H. theodora, Euselasia mys cytis, Mesosemia levis, Eurybia nicaea paulla, Cremna actoris cuyabaensis, Panara thisbe* subsp., *Notheme eumeus hemicosmeta, Chamaelymnas pansa, Rhetus arthurianus, Apodemia paucipuncta, Iaspis violescens, "Thecla" seitzi, "Thecla" melzeri, "Thecla" taunayi, Eurema phiale flavomaculata, Hesperocharis (Cunizza) hirlanda phanasia, Battus (Parides) anchises orbignyanus, B. (P.) burchellanus, B. (P.) diodorus, Microceris variicolor, Udranomia spitzi, Cogia grandis, Anisochoria vianna, Cycloglypha polax, Panoquina chapada*, and *P. bola*. This relatively small list (40 species, 6% of the total) emphasizes the lack of isolation of the planalto by any major mountain range or body of water.

A similarly small number of species and subspecies have reached the heights of the planalto from the Amazon Basin, and are not known to the south of the area in the Serra do Mar. These are mostly Riodinids. A list of the Planalto forms most characteristic of the Amazon Basin and northward is: *Caeruleuptychia brixia brixiola, Argyreuptychia terrestris, Amphidecta calliomma, Narope cyllabarus, Catoblepia berecynthia berecynthia, Aeria elara, Sais rosalia rosalinde, Heliconius sarae thamar, Adelpha serpa paraena, Libythina cuvieri, Evonyme macris phasis, Doxocopa agathina, Prepona eugenes laertides, Perophthalma tullius tullius, Mesosemia sirenia nitida, Mesosemia maeotis, M. melpia, Cremna thasus, Ancyluris colubra colubra, Chorinea amazon, Metacharis cuparina, Charmona caryatis, C. gynaea zama, Amarynthis meneria, Mesene hya monostigma, Symmachia leopardina hilaria, Phaenochitonia cingulis, Emesis cerea, E. lucinda lucinda, Polystichtis lucianus pseudocrispus, Thysanota galena, Juditha lamis lamis, Nymula pelope, Nymphidium*

azanoides, N. leucosia, N. lysimon epiplatea, Theope pieridoides, T. eudocia acosma, Graphium protesilaus protesilaus, Urbanus doryssus doryssus, U. albimargo takuta, Telemiades laogonus nicola, Pythonides herennius herennius, Vittius lafresnayei pica, Morys valerius valerius, and *Justinia phaetusa phaetusa.* The total of 46 represents 7.5% of the list.

An even more select group of species and subspecies found on the planalto show their primary affinity directly eastward to the little-explored forests of the northern Serra do Mar in Bahia. These include *Ypthimoides electra, Hypothyris laphria, Temenis laothoe bahiana, Hypna clytemnestra forbesi, Chamaelymnas tircis, Barbicornis marginata,* and *Papilio himeros baia* (7 species, 1% of the total).

Many of the remaining species (153, 24% of the total) are closely linked with the fauna of the Serra do Mar of southeast Brazil. They are marked on the accompanying list with an asterisk (*). Those species not mentioned above and unmarked on the list are widespread (382 species, 61% of the total).

A summary of distributional affinities by family and subfamily groupings is as follows:

Satyrinae are mostly widespread, with a few showing links, to all sides.

Brassolinae and Morphinae are linked mostly to the south (a few being widespread), except for *Narope cyllabarus* and *Catoblepia berecynthia.*

Danainae are all widespread; Ithomiinae show a good percentage of endemic forms, with other influences from all directions.

Heliconiinae are mostly linked with the south or widespread, with the striking exception of *Heliconius sarae thamar* which is typical of the Amazon Basin.

Nymphalinae/Charaxinae are primarily linked with the south, as are Acraeinae, with some widespread and a few Amazonian forms, as well as a good number of intermediates.

Riodininae show strong and equal influences from the north and the south, with some endemic forms; most members of this group may be widespread but undetected due to their local occurrence and time-restricted flight habits.

Theclinae/Plebejinae are practically all widespread, but may show many endemic forms when all are identified.

Pieridae show two endemic forms, with the others mostly widespread and a few linked to the south.

Papilionidae show many endemic forms in *Battus* (*Parides*) and otherwise include a scattering of material from all sides, but with primary links southward (note especially *Graphium lysithous, Papilio scamander,*

Battus (Parides) nephalion, and *B. (P.) proneus*, all typical of medium to high elevations in the Serra do Mar).

Hesperiidae show a few endemic forms, but practically all are widespread; indeed, most members of this family appear to enjoy wide ranges in tropical America.

Acknowledgements

This work was made possible through the cooperation of a number of persons, including not only the collectors and curators mentioned above (N. Tangerini, P. Gagarin, R. F. d'Almeida, H. S. Lopez, and L. P. Travassos Filho) but also Alfredo Rêgo Barros, of the Museu Nacional, Rio, curator of Lepidoptera; Dr. Inael Máximo da Silva, Director of the EFLEX in Paraopeba, whose hospitality and assistance greatly facilitated the collecting of material in that area; Dr. Paulo Filpo, director, and Dr. João Gino Mândia, administrator of the Parque Zoológico in Brasília, who provided accommodations on two occasions; Dr. Ezechias Heringer of the Botany Department of the Universidade Nacional de Brasília, for entry into areas 7 and 8 as well as transportation in the Brasília area; and many others who assisted in other ways. To all of these we extend our heartfelt thanks. O.M. also thanks the Conselho Nacional de Pesquisas, Brazil, for financial assistance (as a fellowship) permitting the study of Brazilian Lepidoptera.

List of Species

Nymphalidae

Morphinae

1. *Morpho anaxibia anaxibia* (Esp., 1798).*
   SobrdW 1♂s 22-II-66, 3♂s 24-II-66; Fercal 1♂s 25-II-66; Maranhão 2♂s 12-VI-66. Occurrence of fresh males in June was unexpected, but this species occasionally appears in October and November in Rio de Janiero.
2. *Morpho menelaus mineiro* Fruhst., 1913.*
   Vead 3♂; K485 1♂ 26-II-66 (KB); Go 1♂; Km 515 Belo Horizonte-Brasília (Município Paracatú) 1♀ 20-II-66 (OM). Quite rare; the subspecies of southern Minas Gerais. Form lacking white at apex of fw: SobrdW 1♂ (OM) + 3♂s 24-II-66; JZool 1♂ 2-II-62; Anap 1♂ 19-IV-37. May be a separable species (see below), but adequate series not available. Geographical distribution overlapped by typical *mineiro*.
3. *Morpho achillaena paulista* Fruhst., 1912.*
   SobrdW c 22, 24-II-66; Contagem c 23-II-66; Fercal c 23-II-66, 1♀s 25-II-66; Maranhão 1♂ 18-VIII-65, 1♂ 23-II-66; JZool 1♂ 1-II-62, 1♂ 21-II-66; PGama 1♂ 9-VI-66; Vead 2♂; Tag 2♂; Anap 1♂ 20-X-36, 1♂ 5-VI-37, 1♂ 14-VI-37, 1♂ 13-X-37, 1♂ 19-X-37; K485 c 22-VIII-65, c 26-II-66; K222 c 20-II-66; PPW c 19, 27-II-66, c 6, 7-VI-66. Common, variable in proportions of bright and deep blue; genitalia indistinguishable from those of *achillaena*.

We do not foresee the occurrence of other *Morpho* in the planalto, but the list may expand if the recent subdivisions of *achillaena* and *menelaus*

(LeMOULT & REAL, 1962) stand after breeding experiments presently in progress.

SATYRINAE

Where possible, generic names follow Forster (1964). Determinations are by Roberto Spitz (for material in DZ) and the authors, and where uncertain are marked with (?). The first twelve species are characteristic of very deep woods, generally alighting on the ground but sometimes on horizontal leaves, coming readily to bait:

4. *Antirrhea archea* (Hbn., 1822).*
SobrdW 1♂ 22-II-66 (OM).
5. *Taygetis mermeria tenebrosus* (Blanch., 1847).
PPW 1♂ 6-VI-66 (KB), 1♂ 7-VI-66 (KB).
6. *Taygetis armillata* Butl., 1868.
Tag 1♂; PPEflex 1♂ 19-II-66 (KB).
7. *Taygetis larua* Feld., 1867.
SobrdW 1s 24-II-66, 1s 10-VI-66; PPW 2♂ + 4s 19-II-66, c 27-II-66.
8. *Taygetis virgilia* (Cr., 1779).
PGama 1♂ 9-VI-66; PPW 1♂ + 2s 17-II-66.
9. *Taygetis erubescens* Butl., 1868.
Vian 1♂ XI-31; K485 c 22-VIII-65, 1♀ 26-II-66.
10. *Taygetis celia* (Cr., 1782).
SobrdW 1♂ 13-VIII-65, 1♂ 22-II-66, 1♂ 24-II-66; Contagem 1♂ 23-II-66; Fercal 1♂ 25-II-66; Anap 1♂ XI-36; Goiânia 1♂ 29-I-62; Camp 1♂ 24-XII-35, 1♂ I-38; K485 1s 26-II-66. The most common and widespread of the *Taygetis* of the planalto.
11. *Taygetis keneza* Butl., 1869.
Maranhão 1♂ 12-VI-66 (KB). Distinct from *celia*; much smaller, more scalloped wings, underside pattern noticably different.
12. *Taygetis thamyra* (Cr., 1779) [= *andromeda* (Cr., 1779), see Ebert (1965)].
PGama 1♂ 9-VI-66; K222 1♂ 8-VIII-65, 2♂ 20-II-66.
13. *Taygetis echo* (Cr., 1779).
PGama 1s 9-VI-66.
14. *Taygetis kerea* Butl., 1869.
JZool 1♀ 30-I-62; Goiânia 1♂ 1-III-63; Camp 1♂ I-38; PPEflex 1s 27-II-66; PPW 2♂ 1♀ 27-II-66.
15. *Posttaygetis penelea* (Cr., 1779).
Maranhão 1s 15-VIII-65, 1♂ 17-VIII-65, 1♂ 12-VI-66; K485 1s 26-II-66; PPW c 19, 27-II-66, c 6, 7-VI-66.
16. *Amphidecta calliomma* (Feld., 1862).
PPW 1s 6, 7-VI-66. Difficult to capture owing to impenetrable thorny undergrowth. Deep woods; alights on thin, vertical branches, head-up.
17. "*Cercyonis*" *luederwaldti* Spitz, 1931.
SobrdW c 11, 12, 13-VIII-65, 1♀ 22-II-66, c 24-II-66, c 10-VI-66; PGama 1♂ 9-VI-66; Vead 1♂; Vian 6♂ 2♀ III-30, 2♂ XII-31; Ponte Funda, Goiás (near Vian) 2♂ 1♀ 1-III-63. Open grasslands, cerrado, local but common.
18. *Euptychia westwoodi* Butl., 1866.
Maranhão 3♂ 12-VI-66 (KB). Open woods.
19. *Pareuptychia ocirrhoe ocirrhoe* (F., 1777)* (= *hesione*).
SobrdR c 22-II-66; SobrdW c 11, 12, 13-VIII-65, a 22-II-66, c 24-II-66, c 10-VI-66; Contagem c 17, 18-VIII-65, c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 14, 15, 17-VIII-65, 3s 12-VI-66; JZool 1♂ 1♀ 21-II-66; BrasCC

c 11-VI-66; PGama c 9-VI-66; Vead 1♂; Anap 1♂ 26-III-36; Camp 1♂ III-30; Vian 3♂ 5♀ III-30; K222 2s 20-II-66. Generally common in open woods.

20. *Pareuptychia summandosa* (Gosse, 1880).
SobrdW 1♂ 10-VI-66; JZool 2♂ 8-VI-66; BrasCC c 11-VI-66; PGama 1♂ 9-VI-66; Goiânia 1♀ 29-I-62; Camp 1♂ I-38; Ponte Funda, Goiás (near Vian) 1♀ 1-III-63. Open woods, not common.

21. *Pareuptychia* sp.
BrasCC c 11-VI-66. Open woods, evidently very local; distinguished by completely tan underside, without white.

22. *Hermeuptychia hermes hermes* (F., 1775).
SobrdW 1♂ 11-VIII-65, c 22, 24-II-66, c 10-VI-66; Contagem c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 12-VI-66; JZool a 21-II-66, a 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vian 5♂ III-30; K485 c 26-II-66; K222 c 20-II-66; PPEflex c 19, 27-II-66, c 6, 7-VI-66; PPW c 19, 27-II-66, c 6, 7-VI-66. Common in many habitats.

23. *Hermeuptychia calixta* (Butl., 1877).
Vian 1♂ III-30, 1♀ XII-31.

24. *Pharneuptychia pharella* (Butl., 1866).*
Contagem 1♂ 18-VIII-65; Vian 3♂ 1♀ III-30; K485 1♀ 26-II-66; PPEflex 1♀ 7-VI-66. Local, grassy areas.

25. *Caeruleuptychia brixia brixiola* (Butl., 1866).
Camp c III-30. A large collection in DZ.

26. *Euptychoides affinis* (Butl., 1866) (?).
Camp 1♂ III-30.

27. *Yphthimoides yphthima pacta* (Weym., 1911).
Camp 1♂ III-30; Leop 2♂ X-37, 6♂ XII-37; Arag 1♂ XII-31.

28. *Yphthimoides electra* (Butl., 1866).
Camp 1♀ 12-XII-35 (OC).

29. *Yphthimoides celmis* (Godt., 1823).*
SobrdW 1♂ 12-VIII-65, 1♂ 13-VIII-65. Cerrado.

30. *Yphthimoides disaffecta* (Butl. & Druce, 1874) (?).
Arag 1♀ XI-30.

31. *Yphthimoides(?) sylvina* (Feld., 1867).
K222 1♀ 20-II-66 (OM). Woods.

32. *Yphthimoides erigone probata* (Weym., 1911) (?).
Vian 1♂ III-30.

33. *Yphthimoides(?) numeria* (Feld., 1867).
SobrdW 1♂ 11-VIII-65; JZool c 8-VI-66; BrasCC 1♂ 11-VI-66. Open grassland, marshes.

34. *Yphthimoides(?) innocentia* (Feld., 1867).
SobrdW 1♂ 22-II-66, 1♂ 10-VI-66; BrasCC c 11-VI-66; Leop 1♂ XI-37; Vian 2♂ III-30. Open grassland, cerrado.

35. *Yphthimoides mythra* (Weym., 1911).
SobrdR 3♂ 11-VIII-65, 2♂ 12-VIII-65; Camp 4♂ III-30. Open grassland.

36. *Yphthimoides(?) abretia* (Capr., 1874).*
Ponte Funda, Goiás (near Vian) 1♀ 1-III-63 (NT).

37. *Yphthimoides nebulosa* (Butl., 1866) (?).
Vian 1♂ III-30.

38. *Yphthimoides(?) ochracea* (Butl., 1867).
SobrdW 1♂ 11-VIII-65, 1♂ 12-VIII-65, 1♀ 13-VIII-65; Maranhão 1♂ 14-VIII-65. Open grassland, cerrado.

39. *Paryphthimoides eous* (Butl., 1866).
SobrdW c 22, 24-II-66, c 10-VI-66; Contagem c 23-II-66; Fercal c 25-II-66; JZool c 21-II-66, c 8-VI-66; Goiânia 1♂ 30-I-62; Camp 4♂ III-30; K222 c 20-II-66; PPEflex c 19-II-66, c 6, 7-VI-66; PPW a 19-II-66, c 27-II-66, c 6, 7-II-66. Second growth, open woods, cerrado.

40. *Paryphthimoides phronius* (Godt., 1823).
Maranhão 2♂ 18-VIII-65 (KB). Open grassland, marshes.
41. *Haywardina quantius* (Godt., 1803).*
Parac 1♂ 10-VIII-20. Second growth, woods.
42. *Haywardina stelligera* (Butl., 1874).*
Parac 1♀ 20-XII-18, 1♂ 4-III-21. Second growth, woods.
43. *Magneuptychia libye* (L., 1767) (?).
Leop 1♂ III-30; PPW c 27-II-66, 1♂ 7-VI-66. Deep woods. Possibly not this species, but close to it; individuals large, faintly bluish above.
44. *Megisto(?) ocelloides* (Schaus, 1902).
JZool c 8-VI-66; BrasCC 2♂ 11-VI-66; Camp 3♂ III-30, 1♂ I-38. Marshes.
45. *Argyreuptychia(?) terrestris* (Butl., 1866).
SobrdW 1♂ 22-II-66; Vian 7♂ III-30, 1♂ XII-31; K222 1♂ 20-II-66; PPW 1♂ 27-II-66, 1♂ 7-VI-66. Woods.
46. *Praefaunala armilla* (Butl., 1866).
SobrdR 2♂ 22-II-66; SobrdW c 22, 24-II-66; Vead 1♂; Anap 2♂ XII-35; Camp 2♂ III-30, 2♂ 10-XII-35; Vian 1♂ III-30, 5♂ XII-31; Fazenda Saia Velha, south border of D.F., 1♂ 1-III-63. Open grassland, cerrado.
47. *Praefaunala strigillata* (Weym., 1911).
SobrdR c 11, 12, 13-VIII-65; SobrdW c 11, 12, 13-VIII-65, c 10-VI-66; Maranhão 1♂ 15-VIII-65, 1♂ 12-VI-66; BrasCC c 11-VI-66; PPEflex 2♂ 6-VI-66. Replaces *armilla* in winter in the same localities, almost certainly a winter form of the latter; different in markings.
48. *"Euptychia" muscosa* Butl., 1870.*
SobrdW 1♂ 12-VIII-65, c 22-II-66, c 10-VI-66; JZool 1♂ 1-II-62; BrasCC c 11-VI-66; Parac 1♂ 27-III-20. Woods. New genus not yet specified.

With continued progress in determination (we have at least a dozen additional species without names) and collection, the list of Satyrids should arrive at nearly 70, with most of the additions in the "*Euptychia*" group and a considerable number from new *Taygetis*.

BRASSOLINAE

Our arrangement follows the catalogue by Stichel (1932).

All species are dusk-flyers, attracted to bait in the early morning, and occasionally flushed in deep woods during the day.

49. *Brassolis sophorae laurentii* Stich., 1925.*
Vead 1♂; Anap 2♂ 1♀ X-36, 1♀ XI-36, 2♂ XII-36, 1♀ IV-37; Goiânia 1♀ 1962. Seasonally and destructively abundant, feeding on palms.
50. *Narope cyllastros* Dbldy. & Hew., 1849.*
"Rio Maranhão" 1♀ (MN).
51. *Narope cyllabarus* Westw., 1851.
"Rio Maranhão" 1♂ (MN).
52. *Dynastor darius darius* (F., 1775).*
Anap 1♀ 1-36; Uberl 1♂.
53. *Dasyophthalma creusa* Stich., 1904.*
Anap 1♂ 2-I-39.
54. *Opsiphanes cassiae lucullus* Fruhst., 1907.*
Camp 1♂ 25-XII-36; PPEflex 1♂ 26-II-66.
55. *Opsiphanes quiteria meridionalis* Stgr., 1887.*
Vead 1♂.
56. *Opsiphanes invirae remoliatus* Fruhst., 1907.*
SobrdW 1♂ 24-II-66; Vead 1♂; Anap 1♂ X-36.

57. *Catoblepia amphirrhoe* (Hbn., 1825).*
Tag 1♂.
58. *Catoblepia berecynthia berecynthia* (Cr., 1777).
JZool 2♂ 21-II-66; Vead 1♂.
59. *Eryphanis polyxena* (Meerb., 1775).
Anap 1♀.
60. *Caligo illioneus illioneus* (Cr., 1776).
SobrdR 1s 11-VIII-65, 2s 12-VIII-65; JZool 1♂ 21-II-66; BrasCC 2s 11-VI-66; Anap 1♂ X-36; PPEflex 1♂ 27-II-66.

This list of twelve may reach fifteen through the addition of rarer species (such as *Caligo eurilochus*, possibly seen in BrasCC 11-VI-66, *Opsiphanes batea*, or *Dynastor napoleon*).

DANAINAE

61. *Danaus (Danaus) erippus* (Cr., 1775).
SobrdW 1♀ 13-VIII-65; Maranhão 1♀ 18-VIII-65; K485 1♂ 22-VIII-65; PPEflex c 19-II-66, c 6, 7-VI-66; PPW c 27-II-66, c 6, 7-VI-66. Marshes, open country; primarily in areas where *Asclepius curassavica* thrives.
62. *Danaus (Anosia) plexaure* (Godt., 1819).
Tag 1♀. Distinguishable only on close examination from the following common species: *D. plexaure* is rare and local, but probably widespread.
63. *Danaus (Anosia) gilippus gilippus* (Cr., 1775).
SobrdW c 11, 12, 13-VIII-65, c 24-II-66, 2s 10-VI-66; Fercal 1♂ 23-II-66, 2 s 25-II-66; Maranhão c 14, 15, 18-VIII-65, 1♀ 12-VI-66; JZool 1s 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; Vead I♀; Tag 1♂; Goiânia 1♀ 30-I-62; K485 1♂ 26-II-66; K222 1♀ 8-VIII-65; PPEflex 1♀ 19-II-66, c 6, 7-VI-66; PPW c 27-II-66, c 6, 7-VI-66. Common, open areas.
64. *Lycorea ceres ceres* (Cr., 1776).
SobrdW 2s 22-II-66, c 24-II-66; Fercal 2s 23-II-66, 2s 25-II-66; Maranhão c 14, 15-VIII-65; JZool 1♂ 1-II-62, 3♂ 21-II-66; Vead 2♂; PPEflex 2♂ 1♀ 19-II-66, 1♂ 27-II-66; PPW c 27-II-66. Inhabits forest, and is very difficult to distinguish in flight from *Tithorea harmonia pseudethra* and *Heliconius ethillus narceus*.

It is possible that one more species, such as *Ituna ilione*, which enters the blend zone, may be added to the Danaid list.

ITHOMIINAE

All identifications are by Romualdo Ferreira d'Almeida. All Ithomines are typically inhabitants of deep, dark forest, most common in moist areas, and fly irrespective of weather conditions.

65. *Heterossais edessa* (Hew., 1854).
Leop 1♂ III-38. This and the following six species (except *H. salonina*) are transparent-blue and fly low in the shade and are difficult to follow or distinguish in flight.
66. *Hypoleria emyra* Haensch, 1905.
Fercal 1♂ 25-II-66; JZool 1♂ 2-II-62, c 21-II-66, 2♂ 8-VI-66; PGama 1s 9-VI-66; Leop 5♀ III-38; K222 1♂ 20-II-66.
67. *Hypoleria goiana* d'Alm., 1951.
Vead 3♂; Leop 1♀ III-38; PPEflex 3♂ 3♀ 19-II-66, 2♀ 27-II-66; PPW 1♂ 7-VI-66. Very heavily marked.

68. *Hypoleria proxima consimilis* Talbot, 1928.
SobrdW c 22-II-66; Maranhão 1♂ 15-VIII-65; JZool 1♂ 1♀ 21-II-66, c 22-II-66; BrasCC 1♀ 11-VI-66; Vead 1♀; Anap 1♂ 1♀ XI-36, 1♂ 2♀ XII-36, 1♀ 3-II-37; Goiânia 1♀ 5-II-63, 1♂ 7-II-63; Leop 13♂ 4♀ III-38; Vian 1♀ III-30.
69. *Hypoleria salonina* (Hew., 1855).
Contagem 1♂ 23-II-66; Maranhão 1♀ 18-VIII-65; Anap 1♂ XII-35; Leop 7♂ 2♀ III-38; K222 1♂ 8-VIII-65, 1s 20-II-66; PPEflex c 19-II-66, 4s 27-II-66, c 6-VI-66; PPW 1♂ + 3s 6-VI-66, 1♂ 1♀ 7-VI-66. This species differs from our other *Hypoleria* by its transparent-yellow wings.
70. *Pseudoscada erruca* (Hew., 1855).*
PPW 2♂ 27-II-66, c 6, 7-VI-66.
71. *Pseudoscada quadrifasciata* Talbot, 1928.
JZool 1♂ 21-II-66, 1♀ 22-II-66, 1♂ 8-VI-66; Vead 3♂; Anap 1♀ XI-36, 2♂ XII-36, 1♀ 3-II-37; Goiânia 1♀ 29-I-62; Leop 4♂ III-38; Vian 1♀ III-30.
72. *Thyridia themisto* Hbn., 1818.
SobrdW c 22, 24-II-66, c 10-VI-66; JZool 2♂ 1♀ 27-I-62, 2♂ 1-II-62, 1♂ 20-II-63, c 21-II-66, 2♂ 8-VI-66; BrasCC c 11-VI-66; PGama 1s 9-VI-66; Vead 1♂ 1♀; Anap 1♂ XII-35; PPW 1♂ 6-VI-66, 1♂ 7-VI-66. Wings transparent.
73. *Episcada sylvo* (Geyer., 1832).*
JZool c 27-I-62, c 1-II-62, 1♀ 2-II-62, 1♂ 20-II-63, c 21-II-66, c 8-VI-66; Anap 1♀ XII-35; Leop 2♂ III-38. Local, wings transparent-yellow.
74. *Dircenna dero* (Hbn., 1823).*
SobrdR 1♂ 11-VIII-65; SobrdW 2♂ 22-II-66, 1♂ 10-VI-66; Maranhão 2♀ 15-VIII-65; JZool 2♂ 27-I-62, 1♀ 1-II-62; BrasCC c 11-VI-66; PGama 3s 9-VI-66; Tag 1♂; Goiânia 1♂ 30-I-62; Parac 1♀ 10-V-19; K222 2s 20-II-66; PPEflex c 19, 27-II-66, c 6, 7-VI-66; PPW 1♂ 19-II-66, c 27-II-66, c 6, 7-VI-66. Wings transparent.
75. *Dircenna rhoeo* Feld., 1860.*
SobrdR c 22-II-66; SobrdW 1♂ 22-II-66, c 24-II-66, c 10-VI-66; Contagem 1♀ 23-II-66; Fercal c 23, 25-II-66; Maranhão 2♂ 15-VIII-65, 1s 23-II-66; JZool 1♂ 1♀ 27-I-62, 2♂ 1♀ 1-II-62, c 21-II-66; BrasCC c 11-VI-66; PGama 2s 9-VI-66; Goiânia 2♂ 1♀ 6-III-61, 1♂ 27-I-62, 4♂ 4♀ 30-I-62; Vian 6♂ 5♀ III-30, 1♀ XI-31; PPEflex c 19-II-66, 1♀ 6-VI-66, c 7-VI-66; PPW 1♀ 19-II-66, 1♀ 6-VI-66, c 7-VI-66. Relationship to previous species not certain, but probably separate.
76. *Aeria olena* (Weym., 1875).*
SobrdW 1♂ 10-VI-66; Cav 1♂; Tag 1♀; Vian 2♂ 1♀ III-30; PPW a 19, 27-II-66, a 6-VI-66, c 7-VI-66. Local; easily distinguished from following species in flight by darker yellow appearance.
77. *Aeria elara* (Hew., 1855).
SobrdW c 22-II-66, 2♂ + 5s 24-II-66, c 10-VI-66; Contagem c 17, 18-VIII-65, c 23-II-66; Fercal 1♂ 23-II-66, 1♂ 25-II-66; Maranhão c 14, 15, 18-VIII-65, 1♂ 23-II-66, c 12-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Anap 2♂ XI-36, 2♂ XII-36; Goiânia 1♀ 30-I-62; Camp 1♂ I-34; Leop 2♂ 1♀ III-38; Vian 10♂ III-30. Common in forest near Brasília, where *A. olena* is rare.
78. *Oleria aquata* (Weym., 1895).
Maranhão 1♀ 14-VIII-65 (KB); Anap 1♂ XI-36. Low-flying; wings transparent-blue.
79. *Placidula euryanassa* (Feld., 1860).*
PPW 1♂ 6-VI-66. Probably a straggler to the planalto.
80. *Ithomia drymo* Hbn., 1816.
Vian 1♀ III-30. Wings transparent-blue.

81. *Ithomia agnosia agnosia* Hew., 1854.
SobrdR 1♀ 22-II-66; SobrdW c 22, 24-II-66, c 10-VI-66; Contagem c 23-II-66; Fercal c 23, 25-II-66; JZool 1♂ 3♀ 27-I-62, 4♂ 1-II-62, 1♀ 20-II-63, c 21-II-66, c 8-VI-66; BrasCC 2s 11-VI-66; PGama c 9-VI-66; Vead 1♂; Leop 3♂ 3♀ III-38; Vian 1♂ III-30; PPW 1♂ 27-II-66, 1♂ 6-VI-66, c 7-VI-66. Often common; wings transparent-blue; PPW specimens have less white on fw band, similar to subsp. *zikani* d'Alm., 1940.
82. *Hypothyris daeta* (Bvd., 1836).*
SobrdR 2s 22-II-66; SobrdW c 22, 24-II-66; Contagem c 17-VIII-65, 1♂ 23-II-66; Maranhão a 14, 15, 18-VIII-65, c 12-VI-66; JZool 1♂ 21-II-66, c 8-VI-66; Anap 1♂ 1-II-37; PPEflex 1s 19-II-66; PPW 2♂ 19-II-66, 2♂ 27-II-66, c 6-VI-66, 2♂ 7-VI-66. Flies 1–2 m above the ground.
83. *Hypothyris laphria* (Dbldy., 1847).
Maranhão 1♂ 14-VIII-65, 1♂ 1♀ 15-VIII-65 (KB). Occurs together with *H. daeta* but at lower numerical density. *H. laphria* evidently is commoner to the east.
84. *Sais rosalia rosalinde* Weym., 1890.
Goiânia 1♂ 7-III-63; Leop 2♀ III-30, 3♂ 1♀ I-38. Very local.
85. *Mechanitis lysimnia* (F., 1793).
SobrdR c 22-II-66; SobrdW 1♂ 12-VIII-65, c 22, 24-II-66, c 10-VI-66; Contagem c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65, c 23-II-66, c 12-VI-66; JZool 2♀ 27-I-62, c 21-II-66, a 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Tag 1♀; Goiânia 1♂ 2♀ 6-II-61, 1♂ 30-I-62, 2♂ 1♀ 7-III-63; Vian 1♂ 1♀ III-30; K485 c 26-II-66; K222 c 8-VIII-65, c 20-II-66; PPEflex c 19, 27-II-66, c 6-VI-66; PPW c 19, 27-II-66, a 6-VI-66, c 7-VI-66. Widespread, but not usually as common as the following species.
86. *Mechanitis polymnia casabranca* Haensch, 1905.*
SobrdR 1♀ 12-VIII-65, c 22-II-66; SobrdW c 22-II-66, a 24-II-66, c 10-VI-66; Contagem a 23-II-66; Fercal c 23, 25-II-66; Maranhão c 14-VIII-65, c 23-II-66, c 12-VI-66; JZool c 27-I-62, 1♂ 1-II-62, 1♂ 10-III-63, a 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 3♂; Tag 1♂; Anap 1♂ XI-36, 2♂ XII-36, 3♂ I-37; Goiânia 1♂ 6-III-61, 2♂ 27-I-62, 1♀ 30-I-62, 1♂ 1♀ 7-III-63; Vian 2♂ 4♀ III-30, 2♂ XI-31; K485 c 26-II-66; K222 a 8-VIII-65, a 20-II-66; PPEflex a 19, 27-II-66, a 6, 7-VI-66; PPW a 19, 27-II-66, a 6, 7-VI-66. The most widespread and common butterfly of the forests of the planalto. Flies from 0–15 m above the ground.
87. *Xanthocleis psidii pytho* (Feld., 1860).
SobrdW 1♂ 22-II-66 (OM); Vead 1♂; Goiânia 1♂ 30-I-62. Local and rare, flies high and strongly.
88. *Tithorea harmonia pseudethra* Butler, 1873.*
SobrdR 1♀ 13-VIII-65; SobrdW 1♂ 22-II-66, c 24-II-66; Contagem 1♂ 17-VIII-65, c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65, 1♂ 23-II-66, 1s 12-VI-66; JZool 1s 8-VI-66; PGama 9-VI-66; Vead 2♀; Tag 1♀; Anap 1♂ X-36, 1♂ III-37; Goiânia 1♂ 7-III-63; Vian 1♂ III-30; K485 c 22-VIII-65, 2s 26-II-66; K222 c 8-VIII-65, 2s 20-II-66; PPEflex c 19, 27-II-66, c 6, 7-VI-66; PPW c 19, 27-II-66, a 6-VI-66, c 7-VI-66; Go 1♂. Widespread, fairly common; does not reach the southeastern coast of Brazil. Flies fairly high.

One or two Ithomiines may be added to this list, such as *Callithomia xantho methonella* and *Hypoleria plistenes*.

Acraeinae

89. *Actinote surima* Schaus, 1902.*
Leop 2♂ 3♀ III-38. Restricted seasonally, probably more widespread.

90. *Actinote pyrrha* (F., 1775).*
Vead 2♂ 1♀; Goiânia 1♀ 30-I-62, 1♀ 6-III-63; PPW 1s 7-VI-66. Occasionally abundant; variable.
91. *Actinote pellenea* Hbn., 1821.*
SobrdW c 11-VIII-65; Maranhão c 14, 15-VIII-65; JZool 1♂ 1-II-62; Goiânia 1♂ 30-I-62. Erratically seasonal. Identified by small size.

This list of *Actinote* should grow to 5–6 species by diligent year-round collecting.

Heliconiinae

Order and nomenclature in the following list are according to Emsley (1964, 1965).

92. *Heliconius (Heliconius) sarae thamar* (Hbn., 1806).
SobrdR c 11, 12, 13-VIII-65, c 22-II-66; SobrdW 2♂ 12-VIII-65, 2♂ 22-II-66, c 24-II-66, 1♂ 10-VI-66; Contagem 1♂ 23-II-66; Fercal 2s 25-II-66; Maranhão 1♂ 14-VIII-65, 2♂ 18-VIII-65; Vead 1♂ 1♀; Go 1♀ 1926. Identical with specimens from Ecuador or Venezuela; the species may reach its southern limit near Brasília, barely leaving the Amazon River drainage at Sobradinho. Definitely absent from seemingly ideal habitats in JZool, BrasCC, and PGama, 20 km to the south of Brasília.
93. *Heliconius (Heliconius) erato phyllis* (F., 1775).*
SobrdR 2s 22-II-66; SobrdW 1♀ 12-VIII-65, 1♂ 22-II-66, 1♂ 24-II-66; Contagem 1♂ 17-VIII-65, 1♂ 18-VIII-65, c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65, 1♂ 23-II-66, c 12-VI-66; JZool 4♂ 21-II-66, 1♂ 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 1♂ 1♀; Cav 1♂; Tag 1♂; Anap 1♂ 22-III-36, 2♂ 1♀ XII-36, 1♀ II-37; Camp 1♂ I-34, 1♂ I-38; Vian 1♂ III-30; Arag 1♂ II-30; K485 c 22-VIII-65, c 26-II-66; K222 c 8-VIII-65, c 20-II-66; PPEflex c 19, 27-II-66, c 6, 7-VI-66; PPW c 19, 27-II-66, a 6-VI-66, c 7-VI-66. One of the commonest butterflies of the planalto, generally widespread in forests.
94. *Heliconius (Heliconius) melpomene nannus* Stich., 1899.*
SobrdW 1s 22-II-66; Contagem 1♂ 18-VIII-65; Maranhão 1♂ 14-VIII-65, 1♀ 15-VIII-65, 1♂ 23-II-66; JZool 1♂ 1♀ 21-II-66; Tag 1♂. Rare, very local.
95. *Heliconius (Heliconius) besckei* Mén., 1857.*
SobrdR 1♂ 11-VIII-65; SobrdW 1♂ 12-VIII-65, 1♂ 22-II-66, 2♂ 24-II-66; JZool 2♂ 1♀ 20-II-63, 2♂ 21-II-66; PGama 2♂ 9-VI-66; Tag 1♂. This species is sympatric with *H. m. nannus* and is now known to be a distinct species through breeding experiments by Brown & Emsley.
96. *Heliconius (Heliconius) ethillus narceus* Godt., 1819.*
SobrdR c 22-II-66; SobrdW 1♂ 13-VIII-65, c 22-II-66, c 10-VI-66; Contagem 5s 17-VIII-65, c 23-II-66; Maranhão 3s 12-VI-66; JZool 2♂ 1♀ 1-II-62, 1♂ 1♀ 20-III-63, c 21-II-66, c 8-VI-66; BrasCC 2s 11-VI-66; PGama c 9-VI-66; Vead 2♂; Goiânia 2♀ 5-III-63; K222 1♂ 8-VIII-65, 2 s 20-II-66; PPEflex c 19, 27-II-66, c 6-VI-66, 2s 7-VI-66; PPW c 19, 27-II-66, c 6-VI-66, 1♂ 7-VI-66. Widespread, fairly common. Form *polychrous* Feld., 1865.*: SobrdW 1♀ 10-VI-66; Contagem 1♂ 23-II-66; JZool 1♀ 1-II-62, c 21-II-66; Vead 2♂; Goiânia 2♂ 30-I-62; Camp 1♂ I-38; Vian 2♂ III-30; PPW 1♂ 6-VI-66. Predominant in certain areas. Form *satis* Weym., 1875.*: JZool 1s 21-II-66; PPW 1♀ 19-II-66 (OM). This dark form represents a small minority in *ethillus* populations.
97. *Heliconius (Eueides) isabellae dianasus* (Hbn., 1806).*
SobrdR 1♂ 12-VIII-65, 1♀ 13-VIII-65; SobrdW 2♂ 13-VIII-65; JZool 1s 21-II-66, 1♂ 1♀ 8-VI-66; BrasCC 1s 11-VI-66; PPEflex 1♂ 6-VI-66.

98. *Heliconius (Eueides) alipherus* (Godt., 1819).
SobrdR 1s 22-II-66; SobrdW 2s 22-II-66, c 24-II-66, 1s 10-VI-66; Fercal c 17-VIII-65, c 23-II-66; Maranhão 1♂ 14-VIII-65, 1♂ 15-VIII-65, 1s 23-II-66; JZool 2♂ 1-II-62, c 21-II-66; BrasCC 1s 11-VI-66; PGama 1♂ 9-VI-66; Camp 1♂ I-34.
99. *Colaenis iulia iulia* (F., 1775).
SobrdW 1s 24-II-66, 1♂ 10-VI-66; Contagem 2s 23-II-66; Fercal 2♂ 23-II-66, c 25-II-66; Maranhão 1s 12-VI-66; JZool 1♂ 8-VI-66; BrasCC c 11-VI-66; PGama 3s 9-VI-66; Vead 1♂ 1♀; Cav 1♂; PPEflex 5s 19-II-66, 2s 27-II-66, 2s 6-VI-66, c 7-VI-66; PPW c 19-II-66, 5s 27-II-66, c 6, 7-VI-66.
100. *Dione juno juno* (Cr., 1779).
JZool 1♂ 27-I-62, 1♂ 2-II-62, 1♂ 21-II-66; PGama 3♂ 1♀ 9-VI-66. Local; a very dark form.
101. *Agraulis vanillae maculosa* (Stich., 1907).
SobrdR 1♂ 12-VIII-65; JZool 1♂ 27-I-62, 3s 21-II-66; Vead 1♂; Cav 1♀; Anap 1♂ VII-36; PPEflex 1♀ 19-II-66; PPW 3s 19-II-66, 2s 27-II-66, c 6, 7-VI-66.
102. *Dryadula phaetusa* (L., 1758).
SobrdW 1♂ 13-VIII-65; Maranhão 1♂ 17-VIII-65, c 23-II-66; PPEflex c 6, 7-VI-66; PPW 1s 19-II-66, 1♂ 27-II-66, 2s 7-VI-66.

The number of Heliconians might be increased to 13 through the addition of *Eueides vibilius*, *Dione moneta* and/or *Philaethria dido* by more intensive collecting.

Nymphalinae (includes Charaxinae, Apaturinae, Liminitinae)

103. *Phyciodes thymetus thymetus* (F., 1787).*
SobrdR c 13-VIII-65; SobrdW c 10-VI-66; Contagem c 23-II-66; Fercal c 17-VIII-65, c 23-II-66, 1♂ 25-II-66; Maranhão c 14, 15, 18-VIII-65, c 12-VI-66; JZool 1♂ 1-II-62, 1♂ 8-III-63, c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; Vead 3♂; Goiânia 3♂ VIII-43 (OC), 3♂ 4♀ 29-I-62, 1♀ 30-I-62; Camp 1♂ 1♀ (OC), 1♂ III-30, 3♂ 2♀ I-34; Leop 1♀ XII-33; Vian 1♂ III-30; PPEflex 1♂ 19-II-66, c 7-VI-66; PPW c 7-VI-66. Found usually near water, widespread and often common.
104. *Phyciodes sejona* Schaus, 1902.*
Fercal c 17, 18-VIII-65; Maranhão 1♂ 14-VIII-65; Anap 2♂ VIII-36, 2♂ XI-36; Camp 1♀ (OC), 7♂ 2♀ I-34. Streamside, local.
105. *Phyciodes pedrona pedrona* Moulton, 1909.
SobrdR c 11, 12-VIII-65; SobrdW c 11, 12-VIII-65, 1♂ 1♀ 24-II-66, 1s 10-VI-66; JZool 1♂ 21-II-66; BrasCC a 11-VI-66; PGama 1s 9-VI-66; Vead 1♂; Camp 2♂ 1♀; Leop 4♂ XII-33; Vian 4♂ III-30. Flies low in open grassy areas.
106. *Phyciodes angusta* (Hew., 1868).
Vead 4♂; Camp 1♂ (OC), 2♂ I-34.
107. *Phyciodes dicoma* (Hew., 1864).*
SobrdW 1♂ 1♀ 22-II-66, 1♂ 1♀ + 3s 24-II-66; Fercal 1♂s 25-II-66; Vead 3♂; Camp 2♂ I-34.
108. *Phyciodes eunice esora* (Hew., 1857).*
SobrdW 2♂ + 1s 24-II-66, 2s 10-VI-66; Fercal 1s 17-VIII-65; Maranhão 1s 15-VIII-65; JZool 1♀ 21-II-66; PGama 1s 9-VI-66; Vead 2♂; Camp 2♂ 1♀ I-34; Leop 2♂ 1♀ XII-33. Tends towards the Amazonian subspecies, *e. eunice*.
109. *Phyciodes lansdorfi* (Godt., 1821).
SobrdW 1♂ 22-II-66; JZool 1♀ 8-VI-66; Camp 1♂ I-34.

110. *Phyciodes ithra* (Kirby, 1871).
SobrdW 1♂ 11-VIII-65, 1♀ 13-VIII-65, c 22, 24-II-66, 3s 10-VI-66; Fercal 2♂ 17-VIII-65, 2s 23-II-66, 1s 25-II-66; Maranhão 2♂ 14-VIII-65, 1s 12-VI-66; JZool 2s 8-VIII-66; Vead 2♂; Tag 2♂; Anap 1♂ XI-36; Goiânia 1♂ VIII-43 (OC); Camp 1♂ III-30, 9♂ 1♀ I-34; Leop 2♂ 1♀ XII-33; PPEflex c 19-II-66, 1♂ 6-VI-66, c 7-VI-66; PPW c 27-II-66, c 6, 7-VI-66. Widespread and common, many habitats.
111. *Phyciodes hermas* (Hew., 1864).*
JZool 1♀ 21-II-66 (KB). This has been regarded as a southern subspecies of the Antillean *frisia* by some authors.
112. *Chlosyne lacinia saundersi* Dbldy., 1847.
Fercal c 15, 17-VIII-65; PPEflex 1♂ + 1s 7-VI-66; PPW 1s 7-VI-66. Very local.
113. *Vanessa virginiensis brasiliensis* (Moore, 1883).
JZool 1♂ + 1s 8-VI-66 (KB); Vead 1♂.
114. *Vanessa myrinna* (Dbldy., 1849).
SobrdW 1♂ 13-VIII-65; JZool c 8-VI-66; Vead 2♂; Goiânia 1♂ 6-III-63.
115. *Junonia evarete evarete* (Cr., 1779).
SobrdW c 11, 13-VIII-65, c 22, 24-II-66, 3s 10-VI-66; Fercal c 23, 25-II-66; Maranhão c 12-VI-66; JZool c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; Tag 1♂; Anap 1♂ XII-35, 1♂ XII-36, 1♂ 21-XII-36, 1♂ 1♀ II-37, 1♂ 19-II-37 (OC); Leop 2♂ XII-33; Arag 1♀ II-30; K485 c 26-II-66; PPEflex 2s 19-II-66, c 7-VI-66; PPW c 19, 27-II-66, c 6, 7-VI-66. Open roads, grassy areas.
116. *Anartia jatrophae jatrophae* (Joh., 1763).
Maranhão 1♂ 14-VIII-65; JZool 1♂ + 3s 21-II-66, 1♀ 8-VI-66; RClaro 1♂ 13-VIII-63; K485 1♂ 22-VIII-65, c 26-II-66; PPEflex c 19-II-66, c 7-VI-66; PPW 1♂ 19-II-66, 3s 27-II-66, 1s 6-VI-66, c 7-VI-66. Open cultivated areas.
117. *Anartia amathea roeselia* (Eschsch., 1821).*
SobrdR c 11, 13-VIII-65; Fercal c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65, 1♂ 12-VI-66; JZool 2s 21-II-66; Vead 1♂; Tag 1♂; Anap 1♂ 1♀ XII-36, 2♂ 19-II-37 (OC); Goiânia 2♂ 30-I-62, 1♂ 7-III-63; Camp 1♂ 1934 (OC), 1♂ I-34; Parac 1♂ 26-IV-21; PPEflex c 19-II-66, 3s 6-VI-66, c 7-VI-66; PPW 1♂ 19-II-66, 3s 27-II-66, 2s 6-VI-66, c 7-VI-66. Streamsides and marshes, often very common locally. This form is somewhat like the Amazonian *a. amathea*, with the white band on the fw more broken than in typical *roeselia*.
118. *Metamorpha stelenes stelenes* (L., 1758).
SobrdW 1♂s 24-II-66, 1♂ 10-VI-66; Fercal 1♂ + 1s 23-II-66; PGama 1s 9-VI-66; Vead 1♂; K485 2s 26-II-66; K222 1s 8-VIII-65; PPW 1s 19-II-66, 1s 27-II-66, 2s 6-VI-66, 1s 7-VI-66. Widespread but not common.
119. *Metamorpha trayja* (Hbn., 1823).*
SobrdW 1s 12-VIII-65, 1♀ 22-II-66; Fercal 2♂ + 1s 23-II-66; JZool 1♂ 21-II-66; BrasCC 1s 11-VI-66; PGama 1s 9-VI-66; Vead 1♂; Leop 1♂ XII-33.
120. *Hypanartia lethe* (F., 1793).
Fercal c 23, 25-II-66; JZool c 21-II-66, c 8-VI-66; BrasCC 1s 11-VI-66; PGama 2♂ 9-VI-66; Camp 1♂ I-34. In tangled streamside vegetation.
121. *Limenitis (Adelpha) mincia* Hall, 1938.*
Anap 1♂ 23-VII-37 (OC).
122. *Limenitis (Adelpha) abia* (Hew., 1850).*
PGama 1♂ 9-VI-66 (KB). Deep woods near stream.
123. *Limenitis (Adelpha) cocala riola* Fruhst., 1915.*
SobrdW 1♂ 22-II-66; Vead 1♂; Camp 1♂ I-34; Leop 3♂ XII-33; Vian 1♂ 2♀ III-30, 1♂ XI-31.
124. *Limenitis (Adelpha) pleasure heredia* Fruhst., 1915.*
SobrdW 1♂ 11-VIII-65, 1♂ 22-II-66, 2♂ 24-II-66; Maranhão 1♂ 15-VIII-65, 1s 12-VI-66; PPEflex 2s 7-VI-66; PPW 3♂ 19-II-66, 1♂ 1♀ 27-II-66, c 6, 7-VI-66. Forest streams, local.

125. *Limenitis (Adelpha) melona meridionalis* Fruhst., 1915.
Camp 1♂ 1-I-36. In collection of R. F. d'Almeida.
126. *Limenitis (Adelpha) aethalia metana* Fruhst., 1915.*
Contagem 1♂ 23-II-66; JZool c 21-II-66, 1♂ 8-VI-66; BrasCC 1s 11-VI-66; Vead 1♂; Leop 1♂ XII-33. A large and brightly colored race occurring in forests generally, not restricted to streamside situations.
127. *Limenitis (Adelpha) cytherea herennia* Fruhst., 1915.*
SobrdR c 11, 12-VIII-65; SobrdW c 22, 24-II-66, c 10-VI-66; Contagem 2s 23-II-66; Maranhão 1♂ 15-VIII-65; JZool 1♂ 21-II-66, 2s 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 1♂ 1♀; Goiânia 4♂ 1♀ VIII-43 (OC); Leop 1♂ XII-33; Vian 1♂ III-30; K485 2♂ 22-VIII-65, 1♂ 26-II-66; PPW 2s 27-II-66; Ponte Funda, Goiás (near Vian) 2♂ 1-III-63. Along streams.
128. *Limenitis (Adelpha) iphicla iphicla* (L., 1764).
SobrdW 1♂ 22-II-66; Fercal 1♂ 1♀ 23-II-66, 2s 25-II-66; Maranhão 3♂ 14-VIII-65, 1♂ 12-VI-66; PGama 2s 9-VI-66; Vead 2♂; Anap 1♀ 19-II-37 (OC); Camp 2♂ 1♀ I-34, 1♂ 24-XII-35 (OC); Leop 3♂ 1♀ III-33; Vian 1♂ XI-31. Forest streams, or wet sand (males) near forest. Seems closer to *i. iphicla* than to the southern *i. ephesa*.
129. *Limenitis (Adelpha) thoasa gerona* (Hew., 1868).*
SobrdW 2s 10-VI-66; Maranhão 1♂ 14-VIII-65, 1♂ 15-VIII-65, 1♂ 18-VIII-65; Cav 1♂; Anap 1♂ 6-I-37 (OC); Goiânia 1♂ VIII-43 (OC); Leop 1♂ XII-30, 1♂ 1♀ XII-33; Vian 1♂ III-30; Uberl 1♂; K222 1♂ 8-VIII-65; PPEflex 2♂ 19-II-66, 2s 6-VI-66, 1♂ 7-VI-66; PPW 3s 6-VI-66. Along streamsides.

The Museu Nacional also has a specimen of typical *th. thoasa* from "Rio Maranhão"; it is possible that the two subspecies meet at the edge of the Amazon drainage, in the planalto.
130. *Limenitis (Adelpha) serpa paraena* (Bates, 1865).
PGama 1♂ 9-VI-66; Leop 1♂ XII-33; K485 1♂ 26-II-66.
131. *Marpesia petreus petreus* (Cr., 1776).
K485 1♂s 26-II-66. On wet sand; apparently not common.
132. *Marpesia chiron* (F., 1775).
SobrdR 1♂ 12-VIII-65; SobrdW 1s 24-II-66; Fercal 2♂s 23-II-66, 1♂ 25-II-66; JZool 1♀ 21-II-66; PGama 2s 9-VI-66; RClaro 1♂ 19-VIII-63; Camp 3♂ I-34; Leop 1♂ XII-33, 1♂ XII-37; PPEflex 1s 19-II-66; PPW 2s 19-II-66, 1s 27-II-66. On wet sand (males) or at flowers.
133. *Dynamine tithia* (Hübner, 1823).*
JZool 1♀ 27-I-62, 3♂ 1♀ 1-II-62, 1♀ 20-II-63, 2♂ 21-II-66, c 8-VI-66; PGama 1♂s 9-VI-66; Camp 1♂ I-34; Leop 1♂ 1♀ XII-33; PPEflex 1♂ 19-II-66, 1♂ 27-II-66. Local, streamside situations.
134. *Dynamine mylitta mylitta* (Cr., 1782).
Fercal 1♀ + 2♂s 23-II-66, 1♂ 25-II-66; JZool 1♂ 27-I-62, c 21-II-66, c 8-VI-66; PGama 2s 9-VI-66; Camp 1♂ III-30, 4♂ 4♀ I-34.
135. *Dynamine aerata* (Butl., 1887).
Camp 1♂ 1♀ I-34.
136. *Dynamine artemisia* (F., 1793).
SobrdW 1♀ 12-VIII-65, 2♀ 13-VIII-65; Contagem 1♂ 23-II-66; Maranhão 1♂ 14-VIII-65; Cav 2♂; Tag 2♂; Anap 1♂ 16-XI-36, 2♂ 19-II-37 (OC); Camp 1♀ III-30, 3♂ 1♀ I-34, 1♂ 11-XII-35 (OC), 1♀ 20-XII-35 (OC), 1♂ 4-I-36; Leop 1♂ 3♀ XII-33.
137. *Dynamine agacles* (Dalm., 1823).
SobrdW 1♀ 11-VIII-65, 2♂ 12-VIII-65; Fercal c 17, 18-VIII-65, c 23, 25-II-66; Maranhão 1♂ 18-VIII-65, 1♂ 12-VI-66; JZool 1♂ 27-I-62, c 21-II-66, 1♂ 8-VI-66; Vead 1♂; Tag 1♂; Camp 1♀ III-30, 3♂ 1♀ I-34, 1♂ 13-XII-35 (OC), 1♀ 21-I-36 (OC); Leop 1♂ XII-33; Parac 1♂ 22-XII-20. Streamsides and in woods in general.

138. *Dynamine limbata* (Butl., 1877).
Maranhão 1s 12-VI-66; Camp 2♂ I-34, 1♂ 20-XII-35 (OC). Similar to an overgrown *agacles.*

139. *Dynamine athemon maeon* (Dbldy., 1849).*
Fercal 3♂ 17-VIII-65, 1♂ 18-VIII-65, c 23-II-66, 1♂ 25-II-66; Maranhão 1♂ 18-VIII-65; Camp 3♂ 1♀ I-34, 1♂ 15-XII-35 (OC), 1♂ 24-XII-35 (OC); PPEflex 1s 19-II-66. Along streamsides.

140. *Dynamine coenus albidula* Weeks, 1901.
Fercal 1♂ 17-VIII-65, c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65; Tag 4♂; Anap 1♂ VIII-43 (OC); Camp 2♂ III-30, 1♂ I-34, 1♂ 13-XII-35 (OC). Along banks of larger rivers only.

141. *Catonephele numilia penthia* (Hew., 1852).*
SobrdW 1♂ 12-VIII-65, 2♂ 13-VIII-65, 2♂ 22-II-66, 1♂ 1♀ 24-II-66, 1♂ 10-VI-66; JZool 1♀ 1-II-62, c 21-II-66, 1♂s 8-VI-66; Vead 1♀; Anap 1♂ 12-I-37; Leop 1♂ XII-33; PPW 1♂ + 1♀s 27-II-66. Female form *fulva* Röber, 1914: SobrdW 1♀ 12-VIII-65. Female intermediate *penthia-fulva*: SobrdW 1♀ 24-II-66. Female with fw yellow bar reduced to three discrete spots: SobrdW 1♀s 10-VI-66. Deep woods, attracted to sap or banana bait. Females variable; typical form an excellent mimic of *Heliconius sarae.* Form *fulva,* resembling typical females of *n. numilia,* mimics a variety of other *Heliconius* including forms of *erato* and *doris.*

142. *Catonephele acontius* (L., 1771).
SobrdW 2♂ 22-II-66, 1♂ 2♀ 24-II-66; PGama 1♂s 9-VI-66; Leop 2♂ XII-33. Attracted to sap or banana less readily than *numilia*; very local. Females represent an unsolved problem in mimicry studies; *acontius* females resemble only *H. charithonius,* which does not occur in the majority of the range of *acontius.*

The following seven species follow Dillon (1948) except as noted.

143. *Paulogramma peristera* (Hew., 1853).
Vead 1♀; Cav 4♂. Three of the males tend toward the so-called central Brazilian subspecies, *pujoli* (Oberth., 1916); the female is indistinguishable from *p. peristera.* The cline of *peristera* with *pujoli* indicates that the latter is better regarded as a form.

144. *Callicore hydaspes* (Drury, 1782).*
Fercal 1♀ (KB) + 3♂s 23-II-66; Anap 1♀ XI-37; Camp 1♂ I-34; Leop 2♂ XII-33. On wet sand.

145. *Callicore pygas splendens* (Oberth., 1916).
Fercal 2♂ 25-II-66; Maranhão 1♂ 23-II-66; Cav 6♂; Tag 1♀; Anap 1♂ XI-36, 1♂ 19-II-37 (OC); Camp 1♂ I-34; Leop 2♂ XII-33. On wet sand and in nearby forests.

146. *Callicore pygas thamyras* (Mén., 1857).*
SobrdR 1s 13-VIII-65; Cav 1♂ 1♀; Tag 1♀; K485 1♂ 22-VIII-65 (KB). Although different from *C. p. splendens* on both wing surfaces, this is almost certainly the winter (and cold-weather) form of *splendens.*

147. *Callicore selima selima* (Guenée, 1872).*
SobrdR 3♂s 11-VIII-65, 2♂s 12-VIII-65, 3♂s 13-VIII-65, 1♀ 22-II-66; SobrdW 1♀ 12-VIII-65, 1♀ 13-VIII-65, 1♂s 24-II-66, 2♂ 1♀s 10-VI-66; Contagem c 17, 18-VIII-65, 1♀ 23-II-66; Fercal 1♂ 23-II-66, 2♂ + 1♀s 25-II-66; Maranhão 2♂s 14-VIII-65, 1♂ 1♀s 15-VIII-65, 2♂s 18-VIII-65; JZool 2♂s 8-VI-66; PGama 1♂ 9-VI-66; Vead 4♂; Anap 1♂ XI-36, 1♂ 17-XII-36; Goiânia 2♂ 1♀ VIII-43 (OC); Camp 1♂ 6-XII-35 (OC), 4♂ 12-XII-35 (OC); K485 c 22-VIII-65, 1♂ 26-II-66; K222 c 8-VIII-65, c 20-II-66; PPEflex c 19-II-66, 2♀ 27-II-66, 1♀s 6-VI-66, 2♂s 7-VI-66; PPW 1♂s 6-VI-66. Widespread but not always common, generally in forests, readily attracted to sap or banana bait; more easily caught in the winter dry season.

We have specimens of typical *s. selima, s. paulistanus* (Fruhst., 1916), and *s. goyazae* (Dillon, 1948) from all parts of the planalto, the three clearly flying together and occurring in the same brood (although *s. selima* may be more prominent to the southward, *s. goyazae* to the northwest). We thus regard *paulistanus* and *goyazae* as forms of the highly variable nominate *selima*.

148. *Callicore sorana* (Godt., 1823).*
SobrdR c 11, 12, 13-VIII-65; SobrdW c 11, 12, 13-VIII-65, c 22-II-66, 1♂ 24-II-66, 2s 10-VI-66; Contagem c 18-VIII-65; Fercal 4s 23-II-66, c 25-II-66; Maranhão 1♂ 23-II-66, 1♀s 12-VI-66; JZool 1♀ 1-II-62, 1♀ 27-II-63; BrasCC 1♀s 11-VI-66; PGama 1♂s 9-VI-66; Vead 1♂; Cav 2♂ 1♀; Anap 1♂ X-36, 1♂ 12-XII-36, 1♀ 5-II-37, 2♂ 19-II-37 (OC); Camp 1♀ III-30, 1♂ I-34, 2♂ 12-XII-35 (OC), 2♂ 13-XII-35 (OC); Leop 2♂ XII-33; Arag 2♀ II-30; Uberl 1♂; K485 1♀ 22-VIII-65, 1♂ 26-II-66; K222 c 8-VIII-65; PPEflex c 19-II-66, c 7-VI-66; PPW 1♀ 19-II-66, 2s 27-II-66, 3s 6-VI-66; Go 1♀ 1926. Common resident of the cerrado, widespread and occurring in nearly all types of habitat.

149. *Catacore kolyma connectens* (Talbot, 1928).
Fercal 3♂ 23-II-66, 3♂ 1♀ 25-II-66; Maranhão 1♂ 23-II-66; Anap 1♂ 16-XI-36; Camp 1♂ I-34; Vian 2♂ XI-31. On wet sand near forest; hard to distinguish from the following species.

The common form of Goiás has the most reduced amount of red on the forewing underside of all forms of *kolyma*, differing also from typical *connectens* in lacking red on the forewing upperside. The two forms fly together in São Paulo and Paraná, and grade westward to *pasithea* in Bolívia. We conclude from dozens of specimens that it is best not to propose further subspecies of *kolyma*, as there is full intergradation of all extreme forms.

150. *Diaethria candrena* (Godt., 1821).*
SobrdR 1s 12-VIII-65, 2s 13-VIII-65; Fercal c 17, 18-VIII-65, 1♂ 23-II-66, c 25-II-66; Maranhão 1♂ 15-VIII-65, 1♂ 18-VIII-65; Anap 1♂ 7-XII-36, 1♂ 23-XII-36, 2♂ II-37, 3♂ 19-II-37 (OC), 1♂ III-37; Leop 5♂ XII-33. Most easily caught on wet sand.

151. *Diaethria eluina* (Hew., 1852).
Anap 1♂ XII-36, 2♂ 19-II-37 (OC); Goiânia 1♂ VIII-43 (OC); Camp 2♂ I-34; Leop 6♂ 1♀ XII-33; Vian 1♀ XI-31.

152. *Diaethria clymena janeira* Feld., 1862.*
SobrdR c 11, 12, 13-VIII-65; Contagem 1♂ 17-VIII-65, 2♂ 18-VIII-65, c 23-II-66; Fercal c 15, 17, 18-VIII-65, c 23, 25-II-66; Maranhão c 14, 15, 18-VIII-65, c 23-II-66, 1s 12-VI-66; JZool 2♂ 1♀ 27-I-62, 2♀ 1-II-62, 1♂ 20-II-63, c 21-II-66, c 8-VI-66; PGama 2s 9-VI-66; Vead 1♂; Cav 1♂; Anap 1♂ I-36, 1♂ 25-X-36, 2♂ 2♀ XI-36, 1♂ 17-XII-36, 1♂ 19-XII-36, 18♂ 1♀ 19-II-37 (OC); Goiânia 1♂ VIII-43 (OC), 1♂ 7-III-63; Camp 1♂ 2♀ III-30, 2♂ I-34; Leop 5♀ XII-33; Vian 1♂ XI-31; K485 c 26-II-66; K222 5♂ 20-II-66.

153. *Callidula pyrame* (F., 1781).
Fercal 1s 17-VIII-65, c 23, 25-II-66; Cav 2♂; Tag 2♂ 1♀; Anap 1♂ 16-XI-36; Camp 1♂ 1♀ III-30, 9♂ 3♀ I-34. Males are best caught on wet sand, females in nearby brushy tangles.

154. *Epiphile hubneri* Hew., 1861.*
Parac 1♂ 12-XII-19, 1♂ 28-XII-20.

155. *Epiphile orea* Hbn., 1823.*
SobrdW 1♀ 22-II-66, 1♂ + 1♂ 1♀s 24-II-66; Vead 1♂; Anap 1♂ 17-VIII-36, 1♂ 6-I-37 (OC), 1♂ VI-37; Camp 2♂ I-34; Leop 5♂ XII-33; Parac 1♂ 12-XII-19. Deep forest, comes fairly well to bait, difficult to capture without aid of bait.

156. *Temenis korallion* Fruhst., 1912.
SobrdW 1♀ 10-VI-66 (KB); Contagem 1♂ 17-VIII-65 (KB), 1♀s 18-VIII-65; Vead 1♂; Leop 4♂ XII-33.
Easily distinguished from following species by exceptionally dark upperside (iridescent purple in males) and relatively clean, dark brown underside, with discal area of forewing ochre.
157. *Temenis laothoe bahiana* Fruhst., 1907.
SobrdW 1♂ 11-VIII-65, 1♂ 12-VIII-65, 1♂ 13-VIII-65, 1♂s 22-II-66, c 24-II-66; Contagem 1♀ 17-VIII-65, 1♂ 18-VIII-65; Fercal c 23-II-66, 5s 25-II-66; Maranhão 1♂ 23-II-66; PGama 3s 9-VI-66; Vead 2♂; Anap 1♂ 19-II-37 (OC); Camp 2♂ 2♀ I-34, 1♂ 24-XII-35 (OC); Leop 10♂ 4♀ XII-33; Vian 1♂ III-30; K222 1♀ 20-II-66; PPEflex 1s 19-II-66; PPW 1s 19-II-66, c 27-II-66, 3s 6-VI-66, 2s 7-VI-66. In dry woods, occasionally on bait, males sometimes on wet sand.
158. *Nica flavilla flavilla* (Godt., 1823).*
Contagem 1♂ 18-VIII-65; K222 2♂ 8-VIII-65; PPEflex 1s 6-VI-66. Lighter form is more common in winter. Form *lunigera* (Fruhst., 1907): Contagem 1♂ 23-II-66; Fercal 1♀ 23-II-66, 1♂ 25-II-66; Maranhão 1s 12-VI-66; PGama c 9-VI-66; Vead 1♂; Camp 2♂ I-34, 2♀ 26-XII-35 (OC); Leop 1♂ XII-33; Vian 3♂ 1♀ III-30, 1♂ 1♀ XI-31; K222 c 20-II-66; PPW 1s 6-VI-66, 1s 7-VI-66. Darker, the predominant form in the planalto. Local, riparian sites.
159. *Cybdelis phaesyla* Hbn., 1825.*
Leop 1♂ XII-33. Seasonally common.
160. *Libythina cuvieri* (Godt., 1819).
SobrdW 4♂ 1♀ 22-II-66, c 24-II-66, c 10-VI-66; JZool 1♂ 25-III-63; BrasCC 1s 11-VI-66; Vead 1♂ 1♀; Leop 2♂ XII-33, 9♂ 2♀ XII-37; Vian 1♂ III-30, 1♂ 1♀ XI-31, 6♂ XII-31. Occurs only in typical cerrado, flying rapidly among the stunted trees 1 m above the ground. Does not enter the forests.
161. *Evonyme bechina* (Hew., 1852).
SobrdW 1♀ 13-VIII-65; Maranhão 1♂ 23-II-66; JZool c 6-II-62; Vead 1♂; Leop 1♂ 2♀ XII-33, 1♂ X-37, 1♂ XI-37, 4♂ XII-37; Vian 3♂ 1♀ III-30; Arag 1♂ XII-31, 2♂ X-33; K485 1♂ 22-VIII-65. Typical of the dry cerrado, very similar to *L. cuvieri* in habits. At times attracted to bait.
162. *Evonyme volumna intricata* (Fruhst., 1909).
SobrdR 1♂ 12-VIII-65 (KB); Vead 1♂.
163. *Evonyme eurota* (Cr., 1775).
Goiânia 1♂ VIII-43 (OC).
164. *Evonyme caelina* (Godt., 1823).*
Vead 1♂.
165. *Evonyme maja* (F., 1775).*
Arag 1♀ X-31.
166. *Evonyme macris phasis* (Feld., 1862).
Leop 1♂ XII-31.
167. *Mestra hypermestra apicalis* (Stgr., 1888).
Maranhão 1♀ 14-VIII-65, 1♀ 15-VIII-65; JZool 1♂s 8-VI-66; Anap 1♂ 1♀ I-36; Goiânia 2♂ 6-III-63; Camp 2♀ III-30, 5♂ 6♀ I-34, 1♂ I-38; K485 1♂ 1♀ 26-II-66; K222 1♂ 1♀ 8-VIII-65, 2♂ 2♀ 20-II-66; PPEflex c 7-VI-66. Exceedingly variable, from nearly pure white to black, white, and orange, but generally more orange beneath than in coastal *h. hypermestra.*
168. *Ectima liria lirissa* (Godt., 1821).*
Fercal 1♂ 23-II-66 (OM); Camp 3♂ I-34; Parac 1♂ 10-V-19.
169. *Hamadryas chloe rhea* (Fruhst., 1907).
SobrdW 1♂ 10-VI-66; Contagem 4♂ 17-VIII-65, c 23-II-66; Fercal 3s 23-II-66; Maranhão 2s 12-VI-66; Vead 1♂; Anap 1♂ XI-36, 3♂ XII-36, 1♂ 7-XII-36, 1♂ 2-I-37 (OC), 1♂ II-37; Camp 2♂ (OC), 4♂ I-34; Vian 2♂

III-30; PPEflex 1♂ 7-VI-66. All members of *Hamadryas* attracted readily to bait.

170. *Hamadryas ferentina ferentina* (Godt., 1821).
SobrdW 1♂ 12-VIII-65, 1♀ 13-VIII-65, 2♂ 22-II-66, c 24-II-66, 1♂ 10-VI-66; Fercal c 23, 25-II-66; Maranhão a 23-II-66; JZool 1♂ 27-I-62, 1♂ 5-XII-63, c 21-II-66; Goiânia 2♀ 30-I-62, 1♂ 6-III-63; PPEflex 1♂ 19-II-66, 1♂ 7-VI-66. An enormous concentration was noted on manure along a road near the Maranhão, Feb. 23, 1966.

171. *Hamadryas feronia obumbrata* (Fruhst., 1916).*
SobrdR c 22-II-66; SobrdW c 11, 12, 13-VIII-65, c 22, 24-II-66, c 10-VI-66; Contagem 1♂ 17-VIII-65, 1s 23-II-66; Fercal c 23, 25-II-66; JZool 1♂ 22-II-63, c 21-II-66, 1s 8-VI-66; PGama 1♂ 9-VI-66; Vead 1♂; Cav 1♂; Anap 1♂ XI-36; Leop 4♂ 1♀ XII-33; Vian 2♂ 1♀ III-30, 1♂ XI-31. The commonest *Hamadryas* of the planalto.

172. *Hamadryas iphthime gervasia* (Fruhst., 1916) or *epinome* (Feld., 1867).*
JZool 2♂ 21-II-66; Camp 2♂ I-34; Leop 2♂ 1♀ XII-33; Vian 1♂ XI-31; PPW 1♂ 27-II-66, 1♂ 7-VI-66. A species or complex of unclarified taxonomy.

173. *Hamadryas fornax* (Hbn., 1822).
Camp 1♂ I-34; Leop 1♂ XII-33. Rare.

174. *Hamadryas amphinome aegina* (Fruhst., 1916).*
SobrdW 1♂ 11-VIII-65, 1♂ 24-II-66; Fercal 1♂ 23-II-66, 3s 25-II-66; JZool 1♂ 1960, 4♂ 1-II-62, 1♂ 2-II-62, 1♂ 1♀ 6-II-62, 1♂ 20-II-63, c 21-II-66; Vead 1♂; Cav 1♂; PPEflex c 19-II-66, 1♀ 6-VI-66; PPW 2s 27-II-66.

175. *Hamadryas laodamia* (Cr., 1776).
SobrdW 2♂s 13-VIII-65; Contagem 1♀ 17-VIII-65, 1♂ 18-VIII-65; Fercal c 23, 25-II-66; JZool 1♂ 1-II-62, 1♀ 20-II-63, c 21-II-66, 1♀s 11-VI-66; BrasCC 1♂s 11-VI-66; Vead 1♂ 2♀; Anap 1♂ XI-36, 1♂ XII-36, 1♂ 16-VII-37 (OC); Goiânia 1♀ VIII-43 (OC); Camp 1♂ 2♀ I-34; K222 a 8-VIII-65; PPEflex c 19-II-66, 1♂ 1♀ 27-II-66, c 7-VI-66; PPW 2s 27-II-66. Readily attracted to bait, but difficult to capture. Does not "click" as do other *Hamadryas* and shows strong affinities with *Biblis*.

176. *Biblis hyperia hyperia* (Cr., 1779).
SobrdW 1s 12-VIII-65, 1s 13-VIII-65; Fercal 2s 23-II-66, 1s 25-II-66; Cav 1♂; Camp 1♂ III-30, 1♂ I-38; Vian 1♂ XI-31; PPW 1♂ 19-II-66, 2s 6-VI-66. Attracted to bait.

177. *Doxocopa laurentia* (Godt., 1823).*
Fercal 1♂s 23-II-66; Anap 1♂ XII-36, 2♂ 19-II-37 (OC); Leop 2♂ XII-33; Vian 1♀ XI-31. Not easily found; on wet sand (males) or sunny patches in deep woods and flowers (females).

178. *Doxocopa laure lauretta* (Stgr., 1888).*
Fercal c 23, 25-II-66; Maranhão 1♂ 14-VIII-65, 1♂s 12-VI-66; PPEflex 1♂ 6-VI-66; PPW 1♀ 19-II-66, 3♂s 27-II-66. Common on wet sand near forest. Includes several named forms, and may not be distinct from the following species.

179. *Doxocopa selima* (Bates, 1865).*
Fercal 1♂ 25-II-66 (OM); Tag 2♂; Goiânia 1♀ VIII-43 (OC).

180. *Doxocopa agathina* (Cr., 1782).
Fercal 1♂ 18-VIII-65, c 23, 25-II-66; Tag 1♂; Camp 2♂ I-34, 2♂ 22-XII-35 (OC), 1♂ 24-XII-35 (OC); Leop 3♂ XII-33. Wet sand, forested rivers.

181. *Doxocopa vacuna* (Godt., 1823).*
Fercal 1♂ 23-II-66, 1♀ 25-II-66. Wet sand, forested rivers. We regard this as quite distinct from *agathina*.

182. *Pyrrhogyra neaerea arge* Gosse, 1880.*
Goiânia 1♂ 30-I-62; PPW 1♂ 27-II-66 (OM), 1♂s 6-VI-66. Very local; apical spot a little larger than in normal series.

183. *Tigridia latifascia* (Butl., 1873).
SobrdW 3s 22-II-66, 1♂ 1♀ (KB) + 3s 24-II-66, 2♂ (KB) + 5s 10-VI-66; Anap 1♀ 16-XI-36. Exceedingly wary and difficult to catch. Comes to bait, but does not stay upon being approached. Lands head-down on tree trunks, with wings closed; when approached, trembles wings to semi-open, closes again, and seems to hop backwards up the tree-trunk; when flushed, unlike other tree-trunk landing species which fly outward and upward (e.g. *Colobura, Callicore, Hamadryas, Historis, Prepona, Evonyme, Myscelia*), *Tigridia* flies sideways in an unpredictable direction, making several tight circles around the tree before flying away at high altitude.

184. *Colobura dirce* (L., 1758).
SobrdW 2♂ 11-VIII-65, c 22, 24-II-66, 1♂ 10-VI-66; Vead 2♂; Goiânia 1♂ VIII-43 (OC); Leop 1♂ XII-33; K222 2♂ 8-VIII-65; PPEflex 1♂ 19-II-66, 1s 6-VI-66, 1♂ 7-VI-66; PPW 1s 27-II-66. Comes to bait. Often seen on tree-trunks in woods and towns, head downward with wings closed; not easy to catch.

185. *Smyrna blomfildia* (F., 1781).
SobrdW 1♀ 12-VIII-65; Fercal 1♂ 25-II-66; Tag 1♂; PPW 1♀s 27-II-66. At wet sand (males) or bait, not common.

186. *Historis odius odius* (F., 1775).
SobrdW 1♀ 13-VIII-65 (KB), 1♂s 24-II-66; Fercal 1♂s 25-II-66; Vead 1♀. Readily attracted to bait.

187. *Agrias claudia godmani* Fruhst., 1895.
SobrdW 1♂ 22-II-66 (OM), 1♂ 24-II-66 (KB); K485 1♂ 22-VIII-65 (KB). We have only seen this unusual subspecies on bait. Pattern rather variable, from very reduced red on forewing (crescent) and only three narrow lines on veins of hindwing, to considerable red on both wings (all from same brood); much blue iridescence.

188. *Prepona meander* (Cr., 1775).
PGama 1♂ 9-VI-66.
Form *fruhstorferi* Röber, 1914: SobrdW 1♂ 13-VIII-65; Vead 3♂ 1♀. This form has the wing completely tan underneath. Comes to bait; plain form commoner than contrasted nominate form.

189. *Prepona demophon extincta* Stgr., 1886.
SobrdW, 1♂ 24-II-66; PGama 1♀s 9-VI-66; Vead 1♂; Camp 1♂ 1♀ I-34.

190. *Prepona demophoon antimache* (Hbn., 1819).
Vead 1♂.

191. *Prepona laertes laertes* (Hbn., 1811).
SobrdW 1♂ 12-VIII-65 (KB), 1♂ 24-II-66 (KB).

192. *Prepona eugenes laertides* Stgr., 1897.
Anap 1♂ 12-XI-36; Camp 1♂ I-34.
Concepts of the following species are according to Comstock (1961).

193. *Anaea (Siderone) marthesia* (Cr., 1777).
SobrdR 1♂s 22-II-66; SobrdW 1♂ 13-VIII-65, 1♂ 10-VI-66; Vead 2♂ 1♀; Anap 1♀ XI-36; Go 1♂ 1926. Widespread but uncommon, best caught with bait.

194. *Anaea (Zaretis) itys strigosus* (Gmelin, 1788–93).*
SobrdW 1♀ 12-VIII-65, 1♂ 13-VIII-65, 1♂ 22-II-66; Contagem 1♂ 18-VIII-65; Vead 1♂; Vian 1♀ III-30; PPW 1♀ 6-VI-66, 1♂ 1♀ 7-VI-66. Comes readily to bait.

195. *Anaea (Hypna) clytemnestra forbesi* Godm. & Salv., 1884.
Tag 1♂. The southern subspecies (*hubneri*) with the forewing band yellow instead of white, does not seem to pass to the north of the blend zone.

196. *Anaea (Memphis) ryphea phidile* (Geyer, 1834).
SobrdW 3♂s 24-II-66; Contagem 1♂ 17-VIII-65, 1♀ + 2♂s 23-II-66; Fercal

2♂s 23-II-66, c 25-II-66; JZool c 21-II-66; Vead 8♂ 2♀; Tag 1♂; Camp 2♂ I-34; Leop 1♂ XII-33; K222 1♀ 20-II-66; PPW 1♀s 19-II-66, 1♂ + 2♀s 27-II-66, 2♂ 6-VI-66. Widespread and common, on wet sand (males) or bait.

197. *Anaea (Memphis) cratias* (Hew., 1874).*
Cav 2♂; Tag 1♂; Anap 1♂ 21-XII-36; Leop 1♀ XII-33; Vian 1♂ 1♀ XI-31; Arag 1♀ II-30.

198. *Anaea (Memphis) morvus stheno* (Prittw., 1865).
SobrdW 2♂ 24-II-66, 1♂ 1♀ 10-VI-66; Contagem c 17-VIII-65; Maranhão 1♂ 15-VIII-65; JZool 1♀ 27-I-62, 1♀ 1-II-63; Vead 5♂ 1♀; Camp 2♂ I-34; PPW 1♂ 1♀ 27-II-66. Best caught with bait.

199. *Anaea (Memphis) arachne victoria* (Druce, 1877).*
SobrdW 1♂ 11-VIII-65, 1♂ 13-VIII-65, 1♀ 24-II-66; JZool 1♂ 21-II-66; Goiânia 1♂ 30-I-62; Camp 2♂ 24-II-35; PPW 1♀ 19-II-66. Attracted to bait.

We expect to add at least fifteen species to the 97 of Nymphalinae and Charaxinae described here, but it is difficult to predict these. However, the following should occur on the planalto: *Euptoieta hegesia*, two more species of *Phyciodes*, two more species of *Adelpha*, *Dynamine meridionalis* and one further species of *Dynamine*, at least one more *Callicore*, two or more additional species of migratory *Evonyme* (such as *margarita* and *tatila bellaria*), another species of *Prepona* and of *Doxocopa*, *Consul fabius*, and two or three further species of *Anaea (Memphis)* (such as *leonida* or *appias*).

Total for Nymphalidae: 199 species. Predicted to occur on planalto: Approximately 250 species; about 80% represented on present list.

Libytheidae

200. *Libytheana carinenta* (Cr., 1779).
Fercal 1s 17-VIII-65, 1s 18-VIII-65, c 23-II-66; Maranhão 1s 18-VIII-65; JZool 1♂ 1-II-62; Tag 1♂; Vian 1♂ XII-31; K485 1♂ 22-VIII-65; PPW 1s 19-II-66; Go 1♂. Wet sand, riverbanks.

We do not foresee the occurrence of further Libytheidae on the planalto.

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BOOK NOTICE

INSECTS OF HAWAII, Volumes 7 and 8, by Elwood C. Zimmerman. University of Hawaii Press, 535 Ward Avenue, Honolulu, Hawaii 96814, 1958. Volume 7 (Macrolepidoptera): 542 pp., 423 black and white figures. Volume 8 (Pyraloidea): 456 pp., 347 black and white figures. By mail, both $17.50 in United States.

Volume 7 pictures with some detail the 168 species of Macrolepidoptera in 46 genera that were known from Hawaii as of December, 1956. The families Geometridae, Noctuidae and Sphingidae are best represented in the Hawaiian fauna. Of the 158 species of moths treated, 130 are endemic and 28 are foreign introductions. Only two of the ten butterflies in the fauna are endemic. These are *Vanessa tameamea* Eschscholtz and *Vaga blackburni* (Tuely).

Volume 8 contains valuable information pertaining to the 226 species of pyraloid moths, of which 190 are endemic and 36 are foreign introductions. Only four subfamilies of Pyraloidea (Pyraustinae, Scopariinae, Crambinae and Phycitinae) are mentioned as having species endemic to Hawaii.

Both soft-bound volumes contain a checklist of the Lepidoptera mentioned therein, followed by a complete summary of the nomenclatural changes made in each volume and a tabular summary of the endemic Hawaiian species. A discussion of the morphological features and the host-plants of each species is also presented, with keys given in many of the genera.

The black and white photographs comprising most of the figures representing the adults and their genitalia are excellent and are enlarged considerably for detail. Both volumes are essential to anyone interested in the Hawaiian fauna.—GLENN A. GORELICK, *University of California, Berkeley.*

EMBEDMENT OF SPECIMENS IN CLEAR POLYESTER CASTINGS

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The plastic best known for embedment of biological specimens is poly (methyl methacrylate), trade-named "Plexiglas" (Rohm and Haas) or "Lucite" (du Pont), which is prepared by casting methyl methacrylate monomer. The castings have superlative optical properties, but the technique required is rather complex. The monomer must be washed free of inhibitor, a casting syrup must be prepared and degassed by vacuum, an oven (110–115° F.) is required to cure the castings, and final machining and buffing usually are required for planar surfaces because of the extensive shrinkage accompanying polymerization (Anonymous, 1960, Rohm and Haas Co.).

In contrast, the technique for embedment with polyesters is quite simple. Essentially, the procedure consists of building up the casting with a few successive layers of resin and allowing to cure overnight at room temperature. No heat is required, and if the proper mold is used no finishing operations are needed. Optical properties are not so excellent as those of Plexiglas but are still quite good.

Materials and Apparatus

Chemical materials and sources are tabulated below.

Material	*Source*
Plaskon Polyester Resins PE-355 (preferably) or PE-370, and PE-375	Plastics Div., Allied Chem. Corp., P.O. Box 365, Morristown, New Jersey
PL-24 (promoter)	Same
Cobalt Octotate (12% Co)	Nuodex Div., Tenneco Chemicals, Inc., Box 242, Elizabeth, New Jersey
Lupersel DDM (60% methyl ethyl ketone peroxide in dimethyl phthalate)	Lucidol Div., Wallace and Tiernan, Inc., 1740 Military Rd., Buffalo, New York
Styrene (monomer grade)	Dow Chemical Co., Midland, Michigan

Small beakers or the like, glass stirring rods, and molds of some sort are required. A small syringe (e.g., 2 ml capacity) is convenient for dispensing the peroxide catalyst, but a calibrated eyedropper can be used. Appropriate balances are required, of course, for preparing the base mixture as detailed below. A supply of acetone is needed for clean-up of the equipment.

PREPARATION OF POLYESTER BASE

The base is prepared according to the following formulation.

Material	*Parts by Weight*
PE-355	700
PE-375	150
Cobalt Octoate	0.20
PL-24	0.40
Styrene	150

When PE-370 is used in place of PE-355 the PL-24 is reduced to 0.30 parts; in the present work PE-370 gave a very faint yellow tint to castings which in the same thickness (10 mm) were almost quite water-white with PE-355, and on this basis the latter resin is preferred. The above formulation is almost exactly that recommended in the polyester manufacturer's literature (Anonymous, no date, Plastics Div., Allied Chem. Corp.).

The cobalt octoate and PL-24, which are the promoters, are weighed out separately and washed into the mixture of resins with the styrene. Then the material is stirred well to obtain homogeneity.

The reason that two resins are used is that PE-355 (or PE-370) is a rigid resin, while PE-375 is a flexible resin and reduces brittleness in the casting. The additional styrene (the resin already contains a considerable amount) is to reduce viscosity so that air bubbles may escape more readily, and the promoters are needed to assist the catalyst (Lupersol DDM) in giving rapid room-temperature cure.

CASTING TECHNIQUE

For butterflies up to the body size of *Danaus plexippus* (L.) a casting thickness of about 12 mm is adequate, while greater thickness may be needed for heavy-bodied moths. The following examples will illustrate the method of casting.

1. *Petri Dish and Cover as Mold*

This method was used for all but two of the castings in the figure.

The inside of the cover of a Petri dish set (about 14.5 cm inside diameter; depth about 14 mm) was smeared with Johnson's J-Wax (cleaner/wax) and polished with tissue; the object was to clean the glass and leave an imperceptible layer of wax, which can cause a cloudy casting if present in visible amounts. The bottom of the Petri dish itself also was cleaned with the wax for use later in the procedure.

At zero time, 0.30 ml of catalyst (Lupersol DDM) was injected from a 2 ml syringe onto the surface of 55 ml base (using PE-355) in a small beaker, and the mixture was immediately stirred rapidly with a glass

rod for 15 seconds. With no delay, the catalyzed base was poured into the Petri dish cover. The several milliliters remaining in the beaker were washed out with acetone and discarded, and the cleaned beaker and rod were set aside for the next step. The beaker had been marked at 55 ml so that the base could be measured directly into it.

Note that by 6 minutes the air bubbles in the resin usually have risen and broken. Any remaining bubbles may be teased off to the side of the dish with a pin.

At 22 minutes, the first portion of catalyzed base had gelled (did not flow when the dish was tilted), and a second batch was catalyzed and poured. At 26 minutes the bubbles had broken or been teased off to the side, and the specimens (*Heliconius charitonius* (L.) and *Danaus gillippus berenice* (Cramer)), taken from a Riker mount, were dipped in styrene (to prevent entrapment of bubbles by interfacial tension) and placed (at 26 to 28 minutes) in the syrupy liquid UPSIDE DOWN by grasping the underside of the thorax with forceps and forcing the insect down to the gelled layer.

Bubbles trapped under the wings may be worked out by sliding the specimen to one side and teasing out the bubbles with a pin if near the margin.

At 45 minutes the third batch was poured, and at 65 minutes a fourth batch was poured.

At 96 minutes the fifth and final batch was poured, and at 102 minutes the Petri dish itself, which is slightly smaller in diameter than the cover, was placed bottom down by dipping the edge in the still-liquid material near the edge of the mold and slowly lowering it so that the air-liquid interface ran slowly across the glass and the Petri dish finally was left floating on the liquid. Bubbles would have been trapped if the dish had been put down squarely. Some resin overflowed the mold, but no attempt to clean it up could be made at this point.

The assembly was left undisturbed at room temperature (70–75° F.) for 19 hours (from zero time), and then the glass was broken away by striking the edge of the casting with a steel tool handle. Finally, a hacksaw was used to cut away the tacky unprotected surface near the edge (air inhibits surface cure of the resin system), and the edge was filed fairly smooth. A hole for hanging was drilled in the 12 mm thick casting (No. 1 in the Figure).

It should be noted that the castings are advantageously cut and machined at 14–20 hours before they have cured completely and become more likely to crack on mechanical strain. In finishing, it must be remembered that the surface is relatively easily scratched and must be carefully protected.

Figure 1.

2. *Petri Dish Cover as Mold with Plastic Film to Cover Resin Surface*

The first part of the procedure was similar to the above. The second batch was poured at 21 minutes, the specimens (*Colias eurytheme* (Boisduval), male and female) were placed at 27 to 29 minutes, the third batch was poured at 41 minutes, and the fourth batch, only 20 ml of which was used, was poured at 71 minutes. At 78 minutes, an Aclar film (Gen. Chem. Div., Allied Chem. Corp.) of 0.005 inch thickness was laid on the surface (starting at one edge), and bubbles were squeezed out by pressing down on the film. At 14 hours from zero time the film was peeled off easily to leave an excellent plastic surface. Then the glass was broken away, and a square containing the two specimens (No. 2 in the Figure) was hacksawed from the casting. The thickness in this case was 9 mm.

3. *Specially Designed Mold*

The mold is shown in the Figure and consisted of 10 mm thick Teflon (du Pont) pieces bolted to a piece of composition board. A chrome-plated steel (ferrotype) plate covered the bottom of the mold cavity, which measured 9.1×10.7 cm. The Teflon strips were numbered to ensure correct assembly.

A casting (10 mm thick) made with this mold is shown at the right of the mold (No. 3) in the Figure. PE-370 was used in the formulation, and each batch consisted of 37 ml base and 0.20 ml catalyst. The second batch was poured at 20 minutes, the specimens, which had been soaked in styrene for 30 minutes, were placed at 27 to 31 minutes, the third batch was poured at 43 minutes, and the fourth batch (only 12 ml used) was poured at 73 minutes. An Aclar film was laid on the surface at 79 minutes, bubbles were squeezed out, and the assembly was left for 13 hours from zero time.

The casting was removed with great ease, and no finishing was required except for a minute of sanding to remove a little "flash" at the edge.

Cyasorb UV-9 (Am. Cyanamid Co.) is recommended for protection against sunlight (Anonymous, no date, Plastics Div., Allied Chem. Corp.), but when this was used at the specified 3.0 parts (per 700 parts PE-370, etc.) in a casting similar to the above a noticeable yellow tint resulted. If castings are to be kept out of direct sunlight this additive is unnecessary.

Discussion

The only deficiencies in the castings prepared as described above were occasional small bubbles and in some cases an effect which appeared as incomplete wetting at the basal areas of the wings and which developed during cure. Fortunately, the latter effect becomes invisible when the casting is viewed against a white background. Soaking the specimens in styrene for 30 minutes instead of merely dipping them seemed to reduce the occurrence of this condition.

The back surfaces of the castings may be painted with white lacquer if a permanent white background is desired. This was done in the case of the octagonal casting in the Figure.

In conclusion, a peculiarity of embedded specimens is that their wings are permanently "wetted" and transparent. Eliminating the styrene dip, incidentally, does not prevent this. The effect is like that obtained by the old technique of wetting the wings with chloroform or some other solvent to disclose the venation momentarily (Holland, 1931: 15). In the case of *Vanessa virginiensis* (Drury), whose upper and under side patterns differ considerably, the result is a combination of the two patterns whether viewed from above or below. Despite this effect, however,

the species embedded did tend to be easily recognizable, as the Figure shows.

Admittedly, embedment is an undesirable method of preservation for specimens of particular importance not only because the insects are beyond retrieval for dissection but also because of the unnatural transparent appearance described above. However, embedded specimens are permanently protected from accidental breakage and pests and are decorative objects as well as excellent classroom displays to accompany the identification. Embedment may be useful when (1) a permanent view of the venation is desired, especially in relation to pattern (an advantage not afforded when the scales are scraped away to display the veins) and (2) the spatial relationship of upper side vs. under side wing patterns is of interest.

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A NEW PORTABLE BLACK LIGHT

A new portable fluorescent lantern, the Safari Lite, has recently been marketed by the Burgess Battery Company. Although the lantern is sold with an 8 watt "white" light fluorescent tube, it will accept a standard 8 watt BL tube, and appears to be the first truly portable power source for black light collecting.

The Safari Lite operates on either two 69 volt D.C. dry cell batteries or 110 volt A.C. The battery life is claimed to be 100 hrs. The total weight of lantern and batteries is only 9 lbs. The retail price of the lantern with batteries is about $30.00. However, the unit is generally available at discount stores for under $20.00. Replacement batteries can be purchased for about $6.00/pr which makes the cost of operation about 6¢/hr.

It is necessary to remove the plastic shield from the lantern for black light operation in order to avoid filtering the u.v. light. It is probably also desirable to remove the reflector from the lantern to allow 180 degree broadcast by the bulb. With relatively simple modifications it is also possible to use the Safari Lite as a separate "power pack" to operate a 6 watt or 8 watt BL bulb in a trap.

The advantages in cost and convenience of this new black light source over the cumbersome and inconvenient "portable" paraphernalia heretofore available are obvious. The only limitation appears to be in the restricted bulb size that can be operated by the unit.—JOHN H. HESSEL, *6655 Calle de San Alberto, Tucson, Arizona.*

BIOLOGICAL OBSERVATIONS ON *CALLOPHRYS VIRIDIS* (LYCAENIDAE)

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Clench (in Ehrlich and Ehrlich, 1961) states that the larval food plant of *Callophrys viridis* (Edwards) is "probably *Eriogonum latifolium*." In fact, the mature larva and pupa of this species (given as *Thecla dumetorum*) were described in detail by F. X. Williams (1910) in his paper on the butterflies of San Francisco. The present note will present some additional observations made by the present authors and by J. A. Powell of the University of California, Berkeley.

On April 16, 1966 at about 11:00 A.M. the authors observed two females of *C. viridis* in the act of oviposition. The locality is on a ridge leading west from the peak of Mt. San Bruno, San Bruno Mountains, San Mateo County, California. The day was warm and sunny with no wind (an unusual occurrence at this site) and *C. viridis* was flying in large numbers. Just below the ridge top one individual was noted to be displaying the habit of a female in search of an oviposition substrate, *i.e.* making short flights from plant to plant with brief "inspections." After alighting on five or more plants (not *Eriogonum*), the female lit upon a clump of *Eriogonum latifolium latifolium* Sm. The female then slowly walked up one of the developing bloom stalks and back down, whereupon she deposited a single pale green egg on the underside of a young leaf near the base of the bloom stalk. The female spent about one or two minutes on the plant, a period which terminated with the deposition of one egg. The butterfly rubbed its hindwings in an antero-posterioral movement which seemed more vigorous than is usual for this species.

The second female observed in the act of oviposition went through a sequence of events which were essentially identical to those described above.

Coolidge (1924) noted that females of *Callophrys dumetorum perplexa* B. & B. in southern California oviposited "upon the sepals of just unfolding buds, rarely on the leaves" of its food plant, *Lotus scoparius* (Nutt.) Ottley. He noted that females sometimes spent a half hour or more before selecting a suitable site for oviposition.

Both of these species of *Callophrys* feed upon the reproductive portions of their host plants in the larval stage, hence it may be possible that eggs of *C. viridis* are occasionally laid upon the reproductive portions of the plant. However, this is probably an atypical occurrence as almost none of the plants are in bloom while the adults are in flight.

J. A. Powell has corroborated the observations made by Williams that the larvae of *viridis* strongly resemble the color of the blooming flower heads of the *Eriogonum*. On June 5, 1963, while collecting in the San Bruno Mountains, Powell found several larvae of *viridis* resting in exposed areas eaten out of flower heads of *Eriogonum latifolium*. He noted that the larvae, which were pale whitish with pink markings, "closely simulated the general appearance of the flowers." Powell's observations, that the larvae change apparent coloration during their development and that the larvae become a dull reddish just prior to pupation, supplement the detailed description of the variation in larval coloration of this species made by Williams (1910). Reared adults of *C. viridis* were obtained from the larvae collected by Powell and are contained in the collection of the California Insect Survey, University of California, Berkeley. The pupal shells have been examined by John Downey, Southern Illinois University, and are cited in his review of the structure and function of the pupal stridulatory apparatus of Lycaenidae (1966).

It is also noted that *C. viridis* has been found to occur only within the limits of the distribution of nomenotypic *E. latifolium* and not where its other subspecies occur.

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RANGE EXTENSION OF *CALLOPHRYS COMSTOCKI* (LYCAENIDAE)

The authors found *Callophrys comstocki* Henne relatively abundant in a large canyon on the north slope of Clark Mountain, San Bernardino County, California, on April 15, 1966. The habitat is similar to that of the type locality in the Providence Mountains, California, being typical Pinyon-Juniper Woodland in the Upper Sonoran Life Zone. The butterfly was found mainly in the small side canyons of the larger canyon, from 5200 feet to 6000 feet elevation. The new locality is 40 airline miles north of the type locality, which was previously the only known locality. This species should also occur in the New York Mountains, which lie between the Providence Mountains and Clark Mountain.—JOHN F. EMMEL, THOMAS C. EMMEL, *Stanford University, Stanford, California* and JON H. SHEPARD, *Notre Dame University of Nelson, Nelson, British Columbia, Canada.*

THREE NEW SPECIES OF HESPERIIDAE FROM MEXICO

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Since starting a systematic study of the Hesperiidae of Mexico several new species have been discovered, three of which are described below. Two of these were found in material loaned to me for study by Dr. T. Escalante, Mexico, D. F., and the other was in material sent for determination by J. P. Donahue from the Michigan State University collection.

Where reference is made to the venation of the wings or maculation by number, it follows the English system of numbering the veins of each wing from the lowest vein upward.

Astraptes escalantei Freeman, new species

Male. Upper surface of primaries: black, with a heavy overscaling of shiny blue over basal one-third of wing. Some green and blue scales along costa to mid wing. No apical or discal spots. No costal fold. Fringes black.

Upper surface of secondaries: black, with basal one-third of wing overscaled with shiny blue scales and hairs. Termen nearly straight. Fringes black.

Under surface of primaries: dark brown, with an indistinct white tornal area extending to cell. Costa concolorous with rest of wing. A darker brown stripe in the apical region and a darker area from costa through cell to tornal white suffusion.

Under surface of secondaries: dark brown, with two slightly darker bands; one in discal area, the other midway between discal area and base. Costa concolorous with rest of wing.

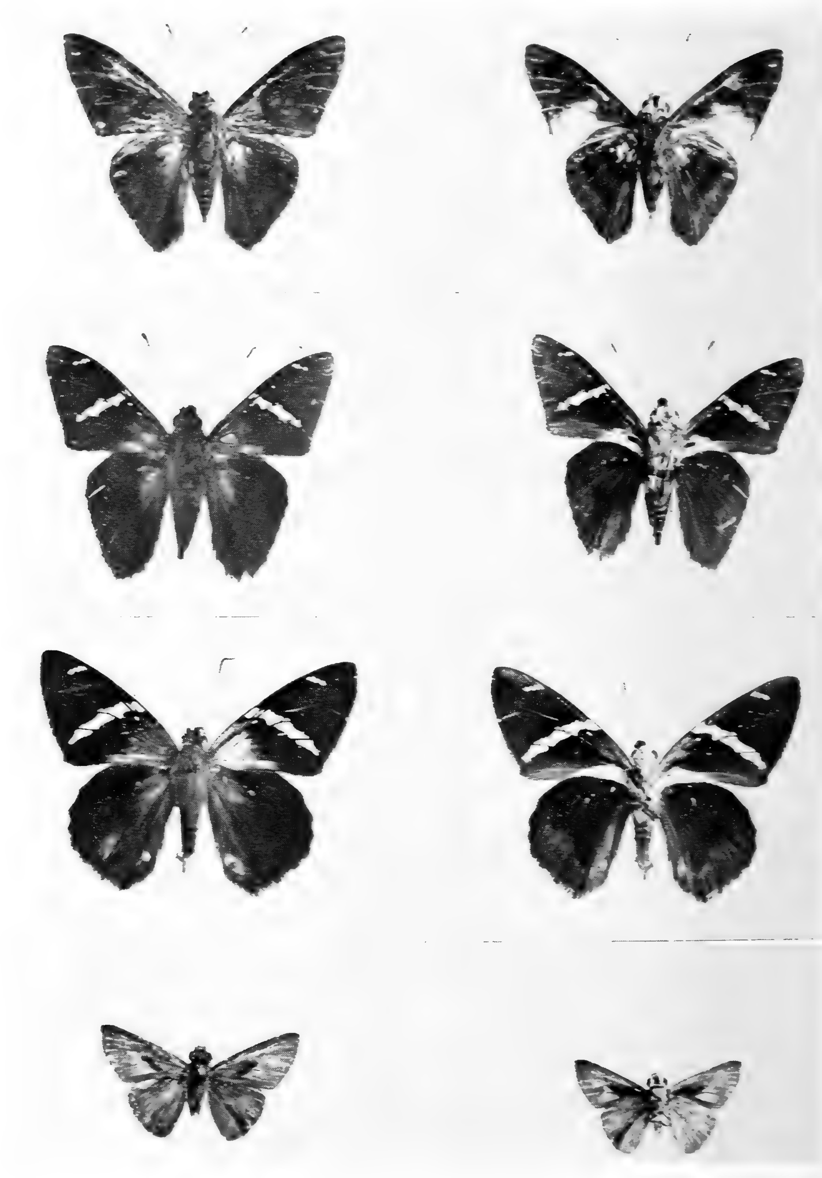
Thorax dorsally greenish-blue, becoming more blue than green near abdomen. Ventral surface of thorax dark brown. Abdomen dorsally brownish-black, heavily overscaled with shiny blue hairs and scales, extending nearly to tip. Abdomen ventrally dark brown. Head dorsally dark green. Palpi, mingled golden and light gray. Legs same color as ventral surface of thorax. Antennae blackish-brown, with the club slender and apiculus bent back against club.

Wing measurements. Holotype male, primaries: base to apex, 27.5 mm; apex to outer angle, 19 mm; outer angle to base, 17 mm; secondaries: base to end of Cu_1, 17 mm; costa to anal angle, 23 mm. Total expanse, 52 mm. Paratype approximately the same size.

Holotype male, Mexico, Ocozingo, Chiapas August, 1948. One male paratype same location, VII-47. These two specimens were received from Dr. T. Escalante, Mexico, D. F., and I take pleasure in naming this species for him. The holotype will be placed in the U. S. National Museum, and the paratype will be retained in my collection.

The nearest relative of *A. escalantei* Freeman appears to be *Acreteus siges* (Mabille) from Brazil. It differs from that species in the genitalia (Compare figure, top left with Evans, 1952: fig. C 14: 28) as well as in

[1] I would like to express my thanks to the National Science Foundation for research grant GB-4122 which is making this study of the Hesperiidae of Mexico possible.



EXPLANATION OF PLATE I

Top row: *Astraptes escalantei* Freeman Holotype ♂, Ocozingo, Chiapas, Mexico, VII-48. 2nd row: *Astraptes catemacoensis* Freeman Holotype ♂, Catemaco, Vera Cruz, Mexico, IX-64. 3rd row: *Astraptes catemacoensis* Freeman Allotype ♀, Catemaco, Vera Cruz, Mexico, IX-64. Lower row: *Euphyes donahuei* Freeman Holotype ♂, 4 miles east San Blas, Nayarit, Mexico, July 17, 1963.

the hind termen of *siges* which is more nearly straight than in *escalantei*. Another difference is that there is no indication of green iridescence at base of costa on the under surface of the primaries in *escalantei* which is present in *siges*. *A. escalantei* belongs in another species of *Astraptes*, the creteus complex. *A. crana* Evans occurs in the same area as *A. escalantei* but can be separated by the color of the costa on the under surface of the primaries. In *crana* it is brown at the base, followed by white to mid wing, whereas in *escalantei* the entire costa is brown.

Astraptes catemacoensis Freeman, new species

MALE. Upper surface of primaries: deep black, with heavy suffusion of blue over basal third of wing. Four small, hyaline, apical spots. Central band of hyaline white, spots compact. Spot in space 3 very small but always present. Costal fold well developed. Outer margin of wing slightly concave, with apex slightly pointed. Fringes concolorous with remainder of wing.

Upper surface of secondaries: deep black, with the basal one-third heavily overscaled with shiny blue hairs and scales. Termen straight. Fringes black.

Under surface of primaries: black, with some lilaceous scales near base and over lower half of wing. All spots of upper surface evident. Costa golden yellow at base, becoming shiny blue to upper edge of cell spot. No indication of darker bands.

Under surface of secondaries: black, with very slight indication of a discal band. Costa, white to mid wing, with a black basal streak having some golden overscaling.

Thorax dorsally shiny greenish-blue, ventrally orange-yellow. Abdomen dorsally dark black, with some greenish-blue coloration near base, ventrally dark brown. Head dorsally green. Palpi yellowish-white. Legs orange-yellow. Antennae black, with some yellowish scales on under side of club. Apiculus bent back against club.

Wing measurements. Holotype male, primaries: base to apex, 29 mm; apex to outer angle, 19.5 mm; outer angle to base, 19 mm; secondaries: base to end of Cu_1, 18 mm; costa to anal angle, 25 mm. Total expanse, 54 mm. Paratypes approximately the same size.

FEMALE. Upper surface of primaries: deep black, with a heavy suffusion of shiny blue over basal one-third. Four well developed, white hyaline, apical spots. Central band of white hyaline spots compact, with a black vein between each. Spot in space 3 triangular and small. Cell spot broad posteriorly, becoming narrower anteriorly. Spot in space 2 long and narrow. Spot in space 1b triangular, and fairly large. Fringes black, becoming slightly lighter in space 1.

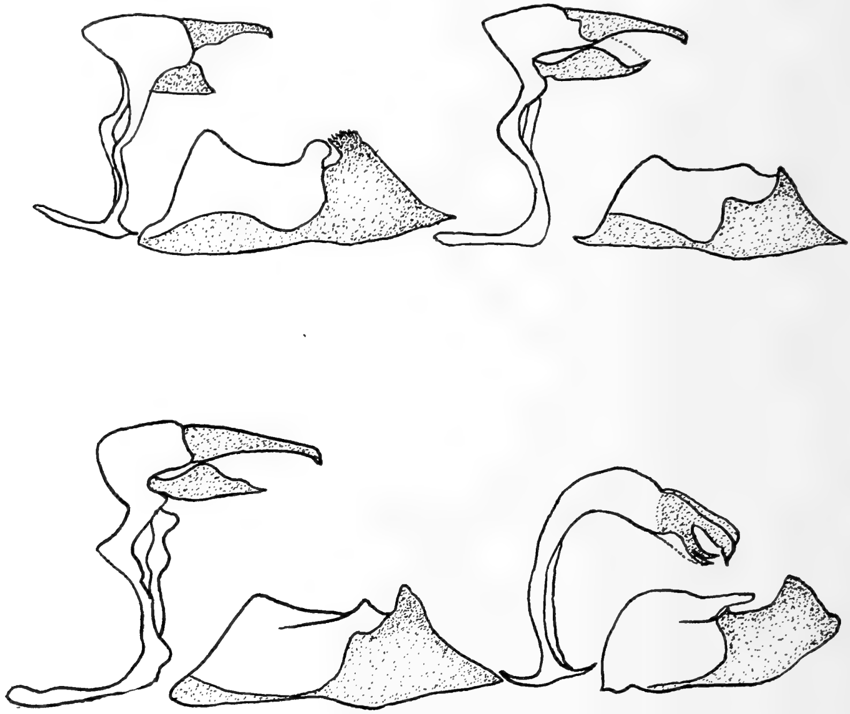
Upper surface of secondaries: deep black, with basal third of the wing heavily suffused with shiny blue hairs and scales. Termen straight from Cu_1 to anal angle. Fringes black.

Under surface of primaries: dull black, with heavy suffusion of shiny blue scales along costa and in cell, extending from base of wing to central spots. Some lilaceous scales between central band and apical spots and near apex. Spot in space 1b edged in clear white. No indication of dark bands.

Under surface of secondaries: brownish-black, becoming darker black from discal area basad. Some faint lilaceous scales between discal area and outer margin. Costa white to beyond mid wing, with indistinct brown line in center at base of wing.

Thorax dorsally dark, shiny blue, with some green hairs present, ventrally orange-yellow. Abdomen dorsally dark black, with basal half suffused with dark, shiny blue hairs, ventrally dark black. Head green and gold dorsally. Palpi yellowish white. Legs orange-yellow. Antennae as in male.

Wing measurements. Allotype female, primaries: base to apex, 33 mm; apex to outer angle, 22 mm; outer angle to base, 21.5 mm; secondaries: base to end of Cu_1, 22.5 mm; costa to anal angle, 26 mm. Total expanse, 60.5 mm.



EXPLANATION OF FIGURES

Male genitalia; lateral aspect of tegumen and associated structures and inner face of valva. Top row: left, *Astraptes escalantei* Freeman; right, *Astraptes fulgerator azul* (Reakirt). Lower row: left, *Astraptes catemacoensis* Freeman; right, *Euphyes donahuei* Freeman.

Holotype male, Mexico, Catemaco, Vera Cruz, September, 1964. Two male paratypes with the same data. Allotype female, same data as males. These four specimens were received from Dr. T. Escalante, Mexico, D. F. The holotype will be placed in the U. S. National Museum. The allotype and one paratype will remain in the Freeman collection, and the other paratype will be placed in Dr. Escalante's collection.

The nearest relative of *Astraptes catemacoensis* is *A. fulgerator azul* (Reakirt) from which it can be separated by the following characteristics: (1) the male genitalia (compare figures, top right with lower left); (2) *catemacoensis* is larger on an average (*catemacoensis* males average 54 mm, *azul* males 49 mm; *catemacoensis* female, 60.5 mm, *azul* females, 52 mm); (3) *catemacoensis* is darker being deep black, whereas *azul* is

brownish-black; (4) the termen of the secondaries of *catemacoensis* is straight, while in *azul* it is generally evenly curved; (5) the fringe of both wings of *catemacoensis* is concolorous with the rest of the wing, while in *azul* it is usually somewhat lighter, and sometimes checkered dark and light; and (6) *catemacoensis* males have the apex of the primaries more pointed than in *azul*.

Euphyes donahuei Freeman, new species

MALE. Upper surface of primaries: brown, with slight indication of a fulvous spot in space 3, just distal to top of broad stigma. No other spots present. Fringes white.

Upper surface of primaries: brown, with slight indication of a lighter area in discal region. Fringes white.

Under surface of primaries: brown, becoming darker near base. Two indistinct, fulvous, discal spots, one in space 3, and one in space 2. A linear lighter area in space 1b.

Under surface of secondaries: brown, evenly overscaled with ochreous scales. No indication of spots.

Thorax dorsally dark brown, lighter ventrally. Abdomen dark brown dorsally, lighter ventrally. Head dorsally dark brown, with some golden-yellow hairs present. Palpi, sordid white, with some intermixed golden-yellow hairs. Legs brown. Antennae black, with a very few yellowish scales on lower surface of the club.

Wing measurements. Holotype male, primaries: base to apex, 16.5 mm; apex to outer angle, 10.5 mm; outer angle to base, 12 mm; secondaries: base to end of Cu_1, 10 mm; costa to anal angle, 12 mm. Total expanse, 35 mm. Paratype smaller, 29 mm.

Holotype male, Mexico, 4 miles east of San Blas, Nayarit, July 17, 1963, J. P. Donahue collector, for whom I take pleasure in naming this species. One male paratype, Mante, Tamaulipas, Mexico, June 22, 1964, H. A. Freeman collector. The holotype will be placed in the U. S. National Museum, the paratype in the collection of H. A. Freeman.

This new species appears to belong to the peneia complex members of which occur in Central and South America. The nearest relative, *Euphyes peneia* Godman, is found in Honduras, Panama, and over a large area of northern South America. *Euphyes donahuei* can be distinguished from *E. peneia* in the following ways: (1) male genitalia, *donahuei* has a longer and somewhat differently shaped cucullus than *peneia* (compare figure, lower left with Evans, 1955: fig. M 28: 11); (2) the fringes of *donahuei* are lighter than those of *peneia*, being white; (3) the under surface of the secondaries is evenly ochreous in *donahuei*, while in *peneia* it is gray-brown, with faint indications of a whitish discal band.

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A TRANSPLANTED COLONY OF *MITOURA GRYNEUS* (LYCAENIDAE) IN KANSAS

During 1956 or 1957 several small specimen trees of Eastern Red Cedar (*Juniperus virginiana*, Linn.) were transplanted from the vicinity of Camdenton, Camden County, Missouri to Johnson County, Kansas. These trees were planted in the general vicinity of the caretaker's house at Camp Towanyak near Lake Quivira in the western part of the county. Apparently the transplanted trees carried with them a small colony of *Mitoura gryneus* (Hubner) that has survived for at least eight years.

M. gryneus was captured here 26-IV-1963 and 21-IV-1965, one was sighted 3-VII-1964 and there are earlier records back to April of 1958. The normal range of *Mitoura gryneus* in Missouri coincides with the Red Cedar Belt extending from the southeast through the southern and eastern Ozarks and into central Missouri. If the colony in Johnson County was established by strays, they would have had to travel one hundred miles or bètter in an unlikely northwestward direction. It is more likely that some individuals were introduced with the trees while in immature stages.

The only previous record of *gryneus* from Kansas was recorded by Field (1938)[1] and involved six specimens taken in July. These were caught by E. A. Popenoe in Riley County many years ago. As Riley County is a distance northwest of Johnson County and even farther away from the Cedar Belt, the Popenoe specimens probably represent a similar case of transplantation. Native populations of *Mitoura gryneus* might be found in Bourbon and Crawford counties, Kansas which are barely reached by a diluted part of the Cedar Belt.—JOHN H. MASTERS, *121 Birch, Mathomedi, Minnesota.*

[1] Field, W. D., 1938. *A Manual of the Butterflies and Skippers of Kansas.* University of Kansas Press, Lawrence, Kansas.

BOOK NOTICE

DIE MACROLEPIDOPTEREN-FAUNA DES GARDASEEGEBIETES [Macrolepidoptera of the region of Lake Garda]. By Josef Wolfsberger—Memorie del Museo Civico di Storia Naturale, Verona. 385 pp., 39 maps, 16 pls. Verona 1966. Price 4.000 Lit.

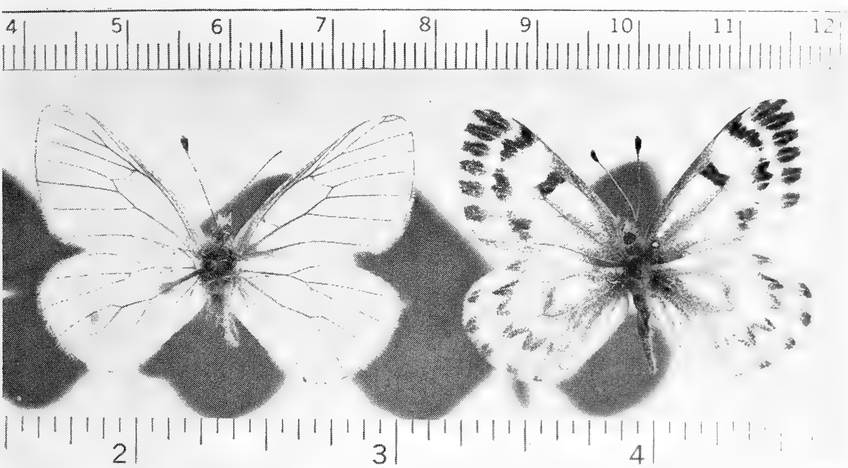
This is the first comprehensive published work on the lepidopterous fauna of the region of Lake Garda [Lago di Garda] in northern Italy. This study includes the environments of the lake and the valley of the river Sarco. The author recorded 1139 species of Macrolepidoptera of which 26 have their northern limit of occurrence in this district. The distributions of the most important species from a faunistic standpoint are shown on 29 maps. Numerous biotopes and imagines are figured on 16 plates.

This new work is very important for all lepidopterists studying the fauna of the Alps. The book is available at the Museum of Natural History in Verona, Italy [Museo Civico di Storia Naturale, Verona].—JOSEF MOUCHA, *National Museum, Dept. of Entomology, Praha, Czechoslovakia.*

AN ALBINIC FEMALE OF *PIERIS SISYMBRII* (PIERIDAE) FROM OREGON

On May 12, 1965 I collected an albinic female of *Pieris sisymbrii* Boisduval at a locality two airline miles northeast of the Buchanon service station on U.S. 20, 4600′, in the ravine of Little Rock Creek which is on the western flank of the Stinkingwater Mountains, Harney County, Oregon. This is an upper Sonoran Zone area predominated by the sage-brush- juniper association.

To my knowledge this rare form has not been noted before and should be of interest to collectors. Originally, it had been misdetermined as an odd form of *Pieris napi*, however Bud Perkins of Portland called the error to my attention.



Pieris sisymbrii Boisduval, dorsal views. Left: female albinic form; right: female form *flava*. Photograph by Don Eames, Portland State College.

Both surfaces of the wings have very faint traces of darker areas where black pigmented scaling occurs in normal individuals. As can be seen in the photograph, the veins stand out quite well against the white background. Seventy-five per cent of the females from this area are the yellowish form *flava* (illustrated for comparison) which have heavy black markings on the dorsal surface of the forewing. The albino was taken with normal males as well as *Pieris beckerii* Edwards.

The specimen is deposited in the author's collection.

Charles R. Crowe, *5027 N.E. 23rd Ave., Portland, Oregon*

FURTHER COMMENTS ON POSSIBLE MIMICRY OF *CAENURGINA CAERULEA* (NOCTUIDAE)

RICHARD GUPPY
Thetis Island, British Columbia

Dr. J. C. Downey (1965), proposes the theory that *Caenurgina caerula* Grt. is a mimic of *Plebejus icarioides* (Bdv.) or, possibly, other blue butterflies. At the suggestion of the author, I am submitting my own observations on the habits of *C. caerulea* and possible models. These are set forth with the idea of making the evidence as complete and accurate as possible, I do not claim that they produce any conclusive arguments either for or against the mimicry theory.

A most certainly incorrect assumption is that *C. caerulea* feeds on lupins. In experiments with caged females, I have found that they oviposit readily on grass, that the larvae thrive on this diet, and produce healthy full sized imagines. Added to this evidence is the fact that other species of the same genus are grass feeders.[1] Thirdly *C. caerulea* is sometimes found a long way from any stand of lupins.

In the matter of flight seasons, *C. caerulea* is a much earlier emerging insect than *P. icarioides*. The moth tends to persist for a rather long period, hence there is considerable overlapping with the butterfly. On southern Vancouver Island at about 1000′, the lowest elevation at which these insects are commonly found, *C. caerulea* flies in a normal season from late April into perhaps the first week of July. *P. icarioides* under the same conditions would be on the wing from early June to early August. Wet, cool weather will cause late emergence in both species, but the flight season of the moth would be more prolonged by such conditions.

The fact that the two species under discussion are often found flying together, is not a good indication of identical ecological requirements. *P. icarioides* is always found near to lupins. Since this is a plant which, on Vancouver Island, keeps to a rather restricted environment, the habitat of the butterfly is similarly limited. As for *C. caerulea*, if the food plant, grass, were the only controlling factor, it would of course be found almost anywhere. Actually it does not appear to invade areas of rich, moist soil, where grass grows strongly. Here it is usually replaced by *C. erechtea* Cramer. *C. caerulea* does, however, have a much less spotty distribution than *P. icarioides*.

[1] According to Crumb (1956, U.S.D.A., Tech. Bull. 1135) *Caeurgina chloropha* feeds on vetch (*Vicia*) and *C. erechtea* and *C. crassiuscula* feed on "clover, lupin and grasses"—ED.

During the early 1950's several Lepidoptera species normally subalpine in habitat occurred plentifully near sea level. *C. caerulea* was noticeable among these, though it still held to its preference for rather barren, dry areas. *P. icarioides* of course, tied to lupins, did not follow the trend. Incidentally, three of the British Columbia localities in Downey's data for *caerulea*, Goldstream, Quamichan, and Victoria, are very unlikely places for *P. icarioides*.

For several winters preceding the above mentioned extraordinary proliferation of subalpine insects, the snowfall had been exceptionally heavy. The theory that winter snow cover is the main factor governing the distribution of some insects is plausible and well supported by the evidence available. Dr. J. A. Powell has, however, pointed out (*in litt.*) that some California localities given by Downey are not subject to any snowfall. The restriction, on Vancouver Island, of *Caenurgina caerulea* to moderate elevations must be for reasons not yet understood.

Of other butterflies mentioned by Downey, *Plebejus melissa* is even later flying than *P. icarioides*, and is similarly limited to lupin areas. On Vancouver Island *Glaucopsyche lygdamus* is only single brooded, and its flight season comes close to coinciding with that of *C. caerulea*. Though commonest around lupins, there are always a few around close to the sea, where they appear to feed on wild peas, *Vicia* spp. Around Victoria *G. lygdamus* is common, using as a host plant cultivated lupins escaped from gardens.

There is really no point in examining each of these butterflies with a view to selecting one as a possible model for *C. caerulea*. Downey seems to exaggerate the predominance of *P. icarioides* in the lupin areas. In this habitat, at least where I have collected, *P. icarioides, P. melissa*, and *G. lygdamus* are about equally plentiful, and their flight seasons overlap to a great extent. I do not think that any one of them can be considered separately. If birds are going to be considered as predators, we must add several other Plebejinae species to the compound model. Birds always range over a good deal of territory, while the lupin patches are fairly restricted. In other nearby habitats, *Everes amyntula* Bdv. and *Lycaenopsis argiolus* Bdv. are very common.

If we suppose the Plebejinae as a whole to be distasteful to some predators, it is difficult to account for so large a group, including many very common species, not having developed more mimics. We can resort to a theory that the predator concerned passes all its life in a small area, such a predator might be a reptile, amphibian or insect. Lizards and toads might be found in the lupin patches, but they do not seem to fulfill the requirements as the distinguishing predators.

They do not habitually take flying insects, and *C. caerulea* does not make a showing of imitating a butterfly when at rest.

Downey has suggested insects as predators, but he does not go into the question of whether they could influence the evolution of this mimic. Nor, so far as I know, has anyone else. In the study of other mimicry associations, there have always been plenty of predators, usually birds, to account for the situation. If insects are known to prey on the model, it has not been deemed necessary to mention them. It is not known whether insects can be induced to alter its prey preferences. Since the prey they take is relatively large, in a given time they must get much fewer stimuli, than is the case with a bird, which can eat hundreds of insects in a day. In addition their lives are short; if they take only as long as a bird to learn a lesson, they have far less time than the bird to exert selective pressure on the potential model.

The insect which most resembles *C. caerulea* in habits and habitat, is a related moth, *Euclidina cuspidea* (Hbn.). These two species seem inseparable, they fly at the same times in the same places (see: Heitzman, 1964). During the expansion of their range, discussed above, both species always turned up together in the same spots. Though I have, once or twice, netted a *C. caerulea* thinking it was a blue, I have far more often taken *E. cuspidea* for the large, dark skippers, *Thorybes pylades* and *Erynnis* spp. The skippers settle usually on the ground, and their flight is of short duration, like that of the moth. One could easily advance the theory that *E. cuspidea* is a mimic of some Hesperiidae, but the actions of both butterflies and moth suggest reliance on cryptic coloration, thus it seems likely that both are palatable to predators. *C. caerulea* also acts very much as if it were trying to escape notice. I intend on future collecting trips to note more carefully whether the grey color (it looks blue only in flight) has any concealing effect when the moth is resting.

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A NEW *BOMOLOCHA* FROM FLORIDA (NOCTUIDAE)

ALEX K. WYATT
Field Museum of Natural History, Chicago, Illinois

Mr. Henry Ramstadt of Chicago spent several winters in Florida collecting insects of various orders. He resided on the premises of Mr. Sam Huffman who had a citrus grove on the west bank of Prairie Creek (a river some 80 feet wide at this point), about five miles northeast of the town of Cleveland in Charlotte County. Mr. Ramstadt's night collecting at light and at sugar was all done on the Huffman premises and day collecting within a mile or two. Unfortunately, the Huffmans used Punta Gorda as their mailing address and Mr. Ramstadt's captures were so labeled instead of being more specific.

Among Mr. Ramstadt's captures was a *Bomolocha* which appears to be undescribed. There is not anything like it in the U.S. National Museum, and Mr. W. H. T. Tams, to whom a black and white photograph was sent for comparison with British Museum material, suggested that the Florida *Bomolocha* should be described as a new species.

Bomolocha ramstadti A. K. Wyatt, new species

FEMALE: *Head*: Palpi porrect, flattened laterally, three times length of head; last segment upturned, white tipped. Antennae very finely bristled. Head and thorax brownish black with some gray scales. *Abdomen*: Tufted, the tufts appearing brownish black and shading down on sides of abdomen to pale cinereous.

Forewing: Basal and median portion between costa and about anal fold, extending outwardly to position of post-median line brownish black, without trace of an antemedial line; edged by a black line, the post-median, beginning at costa about two thirds from base and extending about half way across wing toward inner angle, then curving downward into a straight line toward middle of inner margin to a prominent broad white streak running along anal fold almost to base, then continuing along upper edge of this white streak to near base, then angling obliquely upward with a slight curve to end at base near the subcostal vein; the white streak (by far the most outstanding feature of the species) occupying about half the space between black line and inner margin of wing, portion below dark grayish brown; a dark spot in cell representing the orbicular; reniform quite obscure, indicated by a faint white bar, slightly angled, with a dark shade adjoining it outwardly; a pink or rose colored line running close to and parallel with outer edge of dark area, extending downward to the white streak, set off by white on both sides, obscured at its upper end by a dark shade surrounding apex; apex distinctly white; another dark shade at inner angle of wing; two black spots close to post median, near inner margin, leaving most of area between the basal area and outer margin clouded. Fringes brownish gray with a dark line at base, preceded by light spots between veins.

Hindwing: Even brownish gray with only a slightly darker spot near end of cell. Fringes similar to those of forewing but without lighter spots between veins. Hindwing beneath, glistening, unicolorous, gray, somewhat lighter than hindwing

Bomolocha ramstadti A. K. Wyatt, holotype ♀, 5 miles northeast of Cleveland, Charlotte County, Florida.

upperside, with only the darker spot showing through a little more distinctly than above.

Length of forewing: 15 mm.

Holotype, female: Florida, 5 miles northeast of Cleveland, Charlotte County [labeled Punta Gorda], April 18, 1953; Henry Ramstadt collector; deposited in collection of the Field Museum of Natural History at Chicago, Illinois.

When I sent the photograph of the new species to Mr. Tams of the British Museum (Natural History), I suggested that it might be *B. exoticalis* (Guenée) the type of which was in that museum. Mr. Tams replied saying that it definitely was not *exoticalis*, and enclosed a photo of that type. Some similarity between the two species could be discerned from the photograph of *exoticalis*. The primaries both have a white streak along the anal fold, although there are minor variations in shape and outline. The primaries of *exoticalis* on the whole are distinctly black with no outlining of the basal area. There is an irregular white area with a dark center along the costa, beginning at about the end of the cell and extending outwardly to just before the apex of the wing, where it ends in a point. The apex of the wing is dark, whereas in *ramstadti* the apex is distinctly white, and there is no white area along the costa preceding the apex. There are other minor differences.

Additional collections which presumably represent *B. ramstadti*, are mentioned by Kimball in his 1965 treatment of the Lepidoptera of Florida. Localities which he lists in addition to Punta Gorda, are Gainesville, Archbold Biological Station, and Homestead.

HOST PLANT SPECIFICITY OF THE BLACK SWALLOWTAIL BUTTERFLY, *POLYDORUS ARISTOLOCHIAE* (PAPILIONIDAE)

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Agriculture College, Tando Jam, West Pakistan

Polydorus aristolochiae (Fabricius) is the commonest large-tailed, black butterfly of the Indo-Pakistan Subcontinent. At Tando Jam (25°26′ N; 68°32′ E), West Pakistan, the larvae have been found in large numbers on *Aristolochia bracteata* L. This is a native species of the Family Aristolochiaceae of great medicinal value. Along with other Aristolochias, its anthelmintic properties have been known for some time, from which is derived the local name of "Kidamar" or "Kiramar" (Worm-killer) in many parts of India (Kirtarkar and Basu, 1933).

Host Plant Specificity

Witt (1909), Bell (1911), Wynter-Blyth (1957), and Alam (1962), reported *Aristolochia indica* L., as the only host plant of *P. aristolochiae*. According to Ghosh (1914) the insect probably feeds on all species of *Aristolochia*. He further mentioned that in the field the insect also feeds on Kadu, *Lagenaria vulgaris* Ser. and *Luffa aegyptiaca* Mill. (Cucurbitaceae). Beeson (1941) reported *Aristolochia* spp. and *Diascorea wallichii* (Aristolochiaceae) as the host plants.

There seems to be no record of *Aristolochia bracteata* L. as the host plant of this butterfly. The larvae eat green leaves and fruits. In absence of green leaves, larvae depend totally on green fruits.

Alternate Potential Host Plants

Ghosh (1914) quoted that in 1901, larvae were reported from Surat Farm (25°00′ N; 88°39′ E), Gujrat State, India, as feeding on Kadu Plant, *Lagenaria vulgaris* Ser. (Cucurbitaceae), and in 1905, were reported to be found on *Luffa aegyptiaca* Mill. (Cucurbitaceae), at Darbhanga (31°13′ N; 72°58′ E), Behar, India. In his insectary, however, they did not feed on either of these plants.

Leaves of different plants in the found vicinity of Tando Jam, West Pakistan, on which either the butterfly was found sitting, or where the larvae were found pupating were offered to larvae in the laboratory to see if they would feed on such plants.

Leaves were repeatedly supplied to groups of larvae in cages, petri dishes, glass bottles, and glass chimneys to encourage them to feed. Leaves of the following plants were offered: Akk, *Calotropis procera*

(Asclepiadaceae); Karandi, *Abutilon indicum* (Malvaceae); Kir, *Capparis aphylla* (Capparidaceae); Devi, *Prosopis spicigera* (Leguminaceae); Ber, *Zizyobus rotendifolia* (Rhamnacea); Mango, *Mangifera indica* (Anacardiaceae); and Babul, *Acacia arabica* (Leguminaceae).

In order to study the potential host range of the insect, leaves of the various plants were supplied to the captive larvae in the same manner as were the leaves of *Aristolochia bracteata* L. None of the larvae, aside from those reared on *A. bracteata*, fed upon the leaves and all died of starvation after three to five days.

It is concluded that this species does not have alternate host plant because the larvae refused to feed on all other possible host plants. *Aristolochia bracteata* L. is the only host plant which was recorded in the Tando Jam area.

Acknowledgment

To Kent H. Wilson (Santa Fe, U.S.A.), I extend my sincere appreciation for critically editing, correcting, and improving the manuscript.

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DR. EDWARD PALMER'S COLLECTING LOCALITIES IN SOUTHERN UTAH AND NORTHWESTERN ARIZONA

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Dr. Edward Palmer was an extraordinary man. From a biography written by Rogers McVaugh (1956) I have culled much of my information. He was born in England on January 12, probably in the year 1831, near Wilton in Norfolk. At various times he gave the date of his birth as 1831, 1832, 1833, 1837! He arrived in the United States in 1849. He started his career as a botanical collector in 1852 when he joined the Page Expedition to Paraguay. He studied medicine for a few months in the winter of 1856–57 at the Cleveland Homeopathic College before moving to Highland, Kansas, where he set up to practice that art. In 1860, he was in Denver, Colorado, where he lived for two years, collected plants, and possibly practiced medicine. When the Civil War broke out he joined the 2nd Colorado Regiment and served as its surgeon. He served in this capacity in the Army at various posts in the Southwest. In 1865, he was posted to Fort Whipple in Arizona where he was met by Dr. Elliot Coues, a fellow naturalist. While at these posts Palmer spent all of his free time collecting plants and birds for the Smithsonian and for private collectors. As early as 1865 he also collected insects. His wide interests soon broadened to include archeological collecting and a general study of ethnobotany. He left the Army in 1868 (?) and became a professional field naturalist, often employed by the Department of Agriculture exploring for plants in the Southwest and in Mexico.

1870

In 1870 Palmer left Washington, D.C. in the middle of May and traveled to Salt Lake City by rail. There he engaged passage in a coach and in a week was in St. George, Utah where he spent about ten days. He left St. George on June 17th for St. Thomas, Nevada, now under the waters of an arm of Lake Mead. He ultimately reached the mouth of the Colorado River. For the purpose of this paper we are interested in his stay in Utah and travel as far as St. Thomas.

The types of *Apodemia palmerii* (Edwards) were collected on this trip.

Palmer's Timetable, 1870

May 31—left Salt Lake City by stage coach for St. George, following essentially the present route of U. S. Highway 91.

[1] This study was supported by N.S.F. Grant GB-2741.

June 1–3—Fillmore, Millard Co. These dates are from botanical specimens. It seems unlikely that the stage made the trip from Salt Lake City to Fillmore in a single day. The distance is about 130 miles. I suspect that Palmer arrived late in the day on the 1st and spent the 2nd and 3rd at and about Fillmore.
June 4—Spent the night at Beaver City, presently Beaver, Beaver Co.
June 5—Spent the night at Cedarville, presently Cedar City, Iron Co.
June 7—Arrived at St. George, Washington Co.
June 17—Left St. George, Washington Co.
June 18—Camped in Beaver Dam Mountains west of St. George traveling with a threshing machine being hauled to St. Thomas, Nevada.
June 19—Camp late on the Virgin River "where Beaver Springs empties into it". This is near the present town of Littlefield, Mohave Co., Arizona.
June 20—Arrived at St. Thomas, Clark Co., Nevada, now submerged in Lake Mead, after "I had walked nearly all the time which gave me a chance to collect."

1875–1876

Palmer arrived in St. George, Utah, from San Diego, California, in the middle of October. In St. George he lived with Joseph Ellis Johnson and his family. While he and the children of the family collected some plants and insects, Palmer spent most of his and their time excavating Indian ruins for the National Museum. He left St. George early in 1876 and collected plants in the desert country of Arizona and southern California.

1877

It was on his 1877 trip into southern Utah and adjacent northwestern Arizona that Palmer collected insects in earnest. He had been engaged by the Peabody Museum of Harvard University to excavate further the Indian ruins in the vicinity of St. George, Utah. S. H. Scudder prevailed upon Palmer to make extensive insect collections at the same time. The following itinerary for Palmer during 1877 is based upon data from McVaugh (1956) and from Scudder (1878).

Palmer arrived in St. George, Washington County, Utah, around the 23rd of December 1876. He had been working in the arid southwest for several years collecting plants and anthropological material. It is unfortunate that none of his field notes have as yet been found for the years involved. He used St. George as a base for operation the early half of 1877, until 22 June. During the spring months he roamed as far south as Mt. Trumbull in northwestern Arizona and west to St. Thomas in Nevada, north to Mountain Meadows in Utah and east to Kanab.

His next base appears to have been Paragonah, Iron County, Utah, where he arrived on the 25th of June after a two or three-day wagon trek northeast from St. George. He stayed in this general area until the 10th of July, collecting plants and insects in the vicinity and especially in the mountains. On the 12th of the month he arrived at Beaver, Beaver

County, where he made his base while collecting there in the mountains. He left Beaver on the 21st and by means of a four-day wagon trip reached Spring Lake, just south of Utah Lake in Utah County on the 25th. There he collected archeological material and insects until about the 11th of August. From Spring Lake he struck northward to Salt Lake City where he stayed from the 13th to the end of the month. From there he left Utah and traveled to Davenport, Iowa.

Palmer's Timetable, 1877

December 28, 1876—arrived at St. George, Washington Co. and based until June 22, 1877;
March 1–27—to Johnson (March 12) and Kanab, Kane Co. (March 14), and return;
April 12–25—Beaver Dam [Littlefield] Mohave Co., Ariz. and St. Thomas, Clarke Co., Nev. and return;
April 27–30—to Mokiah Pass, Mohave Co., Ariz., 20 mi. east and south of St. George;
May 1–2—to Juniper Mountains [Cedar Ridges], Mohave Co., Ariz., and returned to St. George on the 4th;
May 12—at Pine Mountain, Washington Co., 20 miles north of St. George enroute to Mountain Meadows;
May 14–22—Mountain Meadows, Washington Co., about 7 mi. east of Enterprise, (on the 19th in Diamond Valley) and returned;
June 1–4—returned for a second time to Mokiah Pass and Juniper Mountain;
June 7–10—Mount Trumbull and returned to St. George on the 15th.
June 22—departed from St. George by wagon;
June 25–26—Paragonah, Iron Co., where he based until July 10th;
July 3–10—at Parowan, Iron Co., 4 miles southwest of Paragonah;
July 4—at "Beaver" [Bear] Valley near "Red Creek" [Paragonah]
July 12—at Copeland's Mill "16 miles SE Beaver City, head of Beaver Cr & near the base of the loftiest peak of the mountains called Balldey Warsatch [sic!] range." en route to Beaver;
July 12—Beaver, Beaver Co., where he based to the 21st;
July 12–18—in the Wasatch Mountains near Beaver;
July 17—at North Creek on the north side of Mt. Baldy;
July 18–20—in the mountains east of Beaver, "Beaver Mountains";
July 21—left Beaver by wagon on a four day trip;
July 25—"Spring Lake Ville" [Spring Lake], Utah Co.;
August 11—left Spring Lake for Salt Lake City. He stayed in the vicinity of Salt Lake City until the end of August.
August 15—visited "Touilla" [Tooele, Tooele Co.], to examine some Indian mounds and apparently did no collecting.

At the outset of his article Scudder (1878: 253) states specifically that he received only forty-one species in the collection from Palmer. These he listed and commented upon and they included four new species: *Neominois dionysus, Anthocharis thoosa,* and *Pholisora libya* described by Scudder in the article and an un-named species of *Erynnis.* Because Scudder's article is little known I recapitulate its information in tabular form.

Almost all of the area visited by Palmer is accessible today by ordinary

TABLE I.—LIST OF BUTTERFLY SPECIES TAKEN BY PALMER IN UTAH AND ARIZONA DURING 1877 AND RECORDED BY SCUDDER (1878).[1] Localities: St. G. = St. George, April–May; Beav. Dam = "Beaver Dam" (Littlefield), April 20–28; Mok. Pass = Mokiah Pass, April 28–30, June 2; Jun. Mts. = Juniper Mountains, May 1–2, June 4; Pine Mt. = Pine Mountain, May 12; Mt. Mdw. = Mountain Meadow, May 14–18; Mt. Trum. = Mt. Trumbull, June 7–10; Bear Vy. = Bear Valley, July 4; Parag. = Paragonah, July 10–11; Beav. Mts. = "Beaver Mountains," July 18–20.

	St. G.	"Beav. Dam"	Mok. Pass	Jun. Mts.	Pine Mt.	Mt. Mdw.	Mt. Trum.	Bear Vy.	Parag.	Beav. Mts.	
SATYRIDAE											
N. dionysus Scud.				vi			*				types
C. ochracea Edw.								*	*		
DANAIDAE											
D. berenice Cram.	*										
NYMPHALIDAE											
L. weidemeyerii Edw.								*		*	
N. antiopa Linn.	*		iv								
V. cardui Linn.									*		
S. "nevadensis"										*	
S. "rupestris"										*	
S. "coronis"										*	
E. "editha"			*		*				*	*	
C. "helcita Bdv"			*		*						possibly *acastus* Edw.
M. arachne Edw.								*			
P. "campestris"					*			*	*		possibly *camillus* Edw.
LYCAENIDAE											
I. "irioides"							*				
S. melinus Hbn.	*										
M. siva Edw.				*					*		
E. amyntula Bdv.											
P. "pheres"						*	*			*	
P. saepiolus Bdv.								*			ssp. *gertschi* dP
L. heteronea Bdv.										*	
P. "battoides"				*							
P. melissa Edw.								*		*	
B. exilis Bdv.	*	*		v							
L. sirius Edw.										*	
L. helloides Bdv.				*				*	*		
PIERIDAE											
C. eurytheme Bdv.	*			*						*	
N. iole Bdv.				*			*			*	
A. thoosa Scud.			*								types
P. "oleracea"										*	
P. protodice Bdv.	*			*				*	*		
PAPILIONIDAE											
P. daunus Bdv.				*							
HESPERIDAE											
E. tityrus Fab.							*				
T. pylades Scud.							*			*	

[1] Names given in quotation marks are incorrectly used by Scudder and not verified or correctable at this time; those in *italics* are acceptable. Abbreviations of current generic assignments are indicated. Scudder's varietal names are here repeated without the species assignments indicated by Scudder.

TABLE I.—Continued.

	St. G.	"Beav. Dam"	Mok. Pass	Jun. Mts.	Pine Mt.	Mt. Mdw.	Mt. Trum.	Bear Vy.	Parag.	Beav. Mts.	
E. "propertius"			iv	v		*					prob. *telemachus* Burns
E. "n. sp."							*				not described by Scudder
A. comus Edw.				vi							
P. communis Gr.	*		*				*	*		*	
H. ericetorum Bdv.			*				*				
P. catullus Fab.	*				*						
P. libya Scud.		*									types
O. sonora Scud.										*	

automobile. The following gazetteer of Palmer's insect localities pinpoints them so that they may be recovered. A good roadmap, supplemented by the "NJ-12" sheets of the U.S.G.S. 1 : 250,000 series,[1] will be ample for the task.

Bear Valley, Iron Co., Utah: ca. 7800′, T33S, R7W, ca. 37°55′N, 112°38′W. Scudder (1878: 253) described Bear Valley as "about 20 miles nearly south of Beaver, surrounded by spurs of the Wahsatch (sic!) Mountains." McVaugh (1956: 147) states: "The Gray Herbarium list of Palmer's collection of 1877 shows that he made about 40 collections of plants at "Beaver Valley near Red Creek, Utah." "Beaver" is probably an error for "Bear," since Bear Valley lies just northeast of Red Creek, off the west slope of Bear Valley Peak." Scudder's date for the insects from Bear Valley, July 4, falls within the span of time during which Palmer collected out of Paragonah. Bear Valley is about 35 miles south of Beaver and is "surrounded by spurs of the Wahsatch (sic!) Mountains." The specimens collected suggest a valley with meadows and a permanent stream. NJ-12-7.

Beaver, Beaver Co., Utah: 5900′, T29S, R7W, 38°17′N, 112°39′W. Beaver is on U. S. Highway 91 in a more or less circular open valley about 10 miles in diameter surrounded by wooded mountains. To the east is the Tushar Range, to the south the uplands connecting them with the Black Mountains, to the west the Mineral Range and the north the uplands connecting the Mineral and Tushar ranges. Palmer's plants from this area are labeled from the "Warsatch" Mountains and the "Beaver Mts." His insect collections suggest mountain meadows at about 8000 feet elevation. His "North Creek" probably is the South Fork of North Creek, heading in Blue Lake north of Shelly Baldy Peak, a spur of Delano Peak (12,173′) and east of Mount Baldy (12,080′). Copeland's Mill probably was somewhere up Beaver Creek on one of its many branches that drain the south and southwest flanks of the Delano massif. NJ-12-4.

"Beaver Dam on the Virgin River" See Littlefield, Arizona.

"Beaver Mountains" See Beaver.

"Beaver Valley" See Bear Valley.

"Copeland's Mill" See Beaver.

"Juniper Mountains," Mohave Co., Arizona: "It is about 20 miles east of south of Mokiah Pass (Scudder, 1878: 254) . . . covered with juniper trees and scrub pines (Scudder, 1878: 253–4)." I have found no such designation on a map. By distance and description it appears probable that "Juniper Mountains" is the wooded portion of Hurricane Ridge east of the L. A. Iverson Ranch about 5 miles north of

[1] Map references, U.S.G.S. 1 : 250,000 series: NJ-12-4 Richfield sheet; NJ-12-7 Cedar City sheet; NJ-12-10 Grand Canyon sheet; NK-12-11 Salt Lake City sheet.

Trumbull P. O. This is the western fringe of the wooded area in which is located Mount Trumbull. The specimens collected suggest a more open and drier locale than either Mt. Trumbull or Mokiah Pass. NJ-12-10.

Littlefield, Mohave Co., Arizona: 1846′, T40N, R15W, 36°53′N, 113°56′W. According to McVaugh (1956: 148) "The modern name of Beaver Dam is Littlefield." It is about 38 miles southwest of St. George by U. S. Highway 91. This is desert country. It is the type locality of *Pholisora libya* (Scudder) and possibly of *Apodemia palmerii* (Edwards). NJ-12-10.

"Mokiah Pass," Mohave Co., Arizona: summit about 5200′, T39N, R12W, 36°48′ N, 113°33′W. Although not named on any map I have seen, this appears to be the pass used by the Arizona continuation of Utah Highway 64 about 20 miles south of St. George. The highway approaches the pass from the north by means of Mokiah Wash. The pass itself lies in the saddle between Wolf Hole Mountain and Seegmuller Mountain in open forest, with patches of grassland, on the basis of the collected specimens. NJ-12-10.

Mountain Meadow, Washington Co., Utah: 6000′, T37-38S, R16W, ca. 37°30′N, 113°37′W. An extensive open grassland about 40 miles north of St. George on Utah Highway 18. NJ-12-7.

Mount Trumbull, Mohave Co., Arizona: summit 8028′, T35N, R8W, 36°25′N, 113°08′W. "The specimens were collected about a spring at the base" (Scudder, 1878: 253). At the southwest base of the mountain is Nixon Spring, approx. 7500′, accessible by wood road east of Trumbull P. O. This can be reached from St. George, Utah, via Utah Highway 64, and its continuation southward in Arizona. Specimens reported from the station suggest an open pine forest with some grassy areas. Mt. Trumbull and its associated mountains are in a portion of the Kaibab National Forest. NJ-12-10.

"North Creek" See Beaver.

Paragonah, Iron Co., Utah: 5880′, T33S, R8W, 37°53′N, 112°46′W. A small town on U. S. Highway 91 at the western flank of the Wasatch Mountains situated in arid land where Red Creek leaves the mountains. Four miles southwest of Paragonah is Parowan, a larger community, similarly situated. According to McVaugh (1956: 270–271) the insects from Paragonah actually were collected at Parowan (July 3–10). Others came from the mountains along Red Creek (July 10–11). The "Paragonah" specimens suggest open grassy hillsides in the juniper-pine zone. NJ-12-7.

"Pine Mountain," Washington Co., Utah: "20 miles north of St. George" (Scudder, 1878: 253) and thus probably in T39S, R16W. It appears to be the pine-clad low mountains west of Utah Highway 18 running north from St. George in the Santa Clara River valley and about 4 miles southeast of Central P. O. Specimens reported are characteristic of open pine forest. NJ-12-7.

"Red Creek" See Paragonah.

St. George, Washington Co., Utah: 2754′, T42S, R15W, 37°06′N, 113°33′W. A thriving small city in an agricultural and mining area that Palmer used as a base for operation from December 1876 through most of June 1877. Situated on U. S. Highway 91. NJ-12-7. Probably the type locality of *Apodemia palmerii* (Edwards).

Spring Lake, Utah Co., Utah: ca. 5000′, T9S, R2E, 40°00′N, 111°45′W. This is Palmer's "Spring Lake Ville," the original homestead of his St. George friend Joseph Ellis Johnson. NK-12-11.

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NEW AND CORRECTED BUTTERFLY RECORDS FOR ONTARIO AND FOR CANADA

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While arranging the butterfly collection of the Royal Ontario Museum, University of Toronto, the present writer discovered some interesting new records of butterflies from Ontario, some of which establish new records for Canada. These records are presented in two sections. The first represents additions to my previous summaries of the distribution of butterflies in northern Ontario (Riotte, 1959 and 1962). The second section contains additions to C. J. S. Bethune's work (1894) on the butterflies of the eastern provinces of Canada, which is still the only available list of the butterflies in southern Ontario.

I. Additions to the northern Ontario list:

a) Additional species

Pieris occidentalis Reakirt: this should replace the entry of *Pieris protodice* Boisduval and Le Conte in Riotte (1959). The northern Ontario population is quite distinct from the southern one. The specimens from Lansdowne House in the Royal Ontario Museum conform to a long series of this butterfly from Manitoba, Alberta and British Columbia. Also the male genitalia show the same characters both in the Ontario and in the western specimens and are quite different from and easily separated from the genitalia of the southern Ontario *protodice*. Following Chang (1963) *occidentalis* is treated here as species. In Ontario *occidentalis* and *protodice* do not overlap geographically. As far as known there are approximately 700 mi. between the two populations.

Satyrium edwardsii Saunders: Fort William—mid-August.

Callophrys (*Incisalia*) *eryphon* (Boisduval): Nakina, (Lake) Nipigon, Quetico Park—late May to mid-June. The locality "Quetico Park" should be deleted under no. (413) in Riotte (1959). The writer was warned of the possibility of the occurrence of *eryphon* in Ontario by what seemed to be a unique collection of this species in Michigan, in Luce and Chippewa Counties, by M. C. Nielsen (1966). *C. eryphon* and *niphon* are very easily mistaken for one another and dissection is advisable to insure proper identification. In the case in question, the Ontario specimens correspond to a series of *eryphon* from British Columbia and an examination of the genitalia confirmed that they were *eryphon*. This occurrence of *eryphon* in the east is analogous to the occurrence of the "eastern" *niphon* in Colorado, as published by F. M. Brown (1955).

Everes comyntas (Godart): Geraldton, Nakina, S. Neebing Township

(Thunder Bay District), Nipigon, Sudbury—late June to mid-August. This species is an interesting addition to the northern butterfly fauna. It is found with *E. amyntula* (Boisduval), *e.g.* at Geraldton, Nakina, Nipigon, Sudbury. It has a partial second generation in warm years.

Oeneis melissa semplei Holland: Cape Henrietta Maria, July 6 and 13, 1948.

Oeneis polixenes (Fabricius): Fort Severn, July 9, 1940. This and the foregoing species should replace *Oeneis t. taygete* Geyer in Riotte (1959), according to recent determinations.

b) Additional localities for previously recorded species

Papilio machaon hudsonianus Clark: Cochrane, May 24, 1958 the southeasternmost known occurrence), S. Neebing Township (Thunder Bay District, 5 miles SW of Fort William), June 21, 1963 (the southernmost known occurrence).

Papilio glaucus canadensis Rothschild & Jordan: Peninsula (Thunder Bay District).

Euchloe ausonides mayi Chermock & Chermock: Geraldton, 7 mi. E. of Jellicoe.

Callophrys (*Incisalia*) *augustinus* (Westwood): Driftwood, 106 mi. W. of Kapuskasing.

Vanessa atalanta (Linnaeus): S. Neebing Township (Thunder Bay District).

Nymphalis milberti (Godart): S. Neebing Township (Thunder Bay District).

Phyciodes batesii (Reakirt): Amyot.

Melitaea nycteis drusius (Edwards): Amyot.

Boloria f. freija (Thunberg): Driftwood, Monteith.

Boloria titania grandis (Barnes & McDunnough): Mississauga.[1]

Boloria eunomia dawsoni (Barnes & McDunnough): Nipigon, 10 miles NE of Nipigon.

Speyeria aphrodite winni (Gunder): Favourable Lake.

Cercyonis pegala nephele (Kirby): S. Neebing Township (Thunder Bay District).

Oeneis macounii (Edwards): Nakina.

Erebia d. discoidalis (Kirby): Monteith (observed), Nakina.

Hesperia sassacus manitoboides (Fletcher): has been re-taken in Nipigon on June 27, 1966; up till now the original specimens collected by Fletcher at Nipigon in 1901 were the only known ones from this locality.

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[1] Correction: In Riotte (1962) "Oog Lake" under *Boloria titania grandis* should read "Dog Lake." In addition, "S. Neeling twsp." should read "S. Neebing twsp." through the whole paper.

II. Additions to the southern Ontario list:

Phoebis sennae eubule (Linnaeus): one male and one female, Point Pelee, September 20, 1953; new for Canada.

Phoebis philea (Johansson): two females, Vineland, July 1944 and September 1930; new for Canada, considered to be a straggler from the south.

Nathalis iole Boisduval: Bridgenorth near Peterborough, 1947; Sault Ste. Marie, without further dates, in the Lyman Collection (Macdonald College, Ste. Anne-de-Bellevue, Qué.).

Callophrys (*Incisalia*) *eryphon* (Boisduval): Port Hope.

Asterocampa celtis (Boisduval and Le Conte): Pelee Island, July 5–14, 1950; July, 7–9, 1965; Point Pelee, June 29, 1965.

Asterocampa clyton (Boisduval and Le Conte): Kitchener, no date available; London, July 11, 1955 (in the collection of the University of Western Ontario in London); Pelee Island, July 13–27, 1950; Point Pelee, August 20, 1920.

Speyeria idalia (Drury): Grand Bend, no date available; Hyde Park Corner, September 7, 1919; Rondeau Park, 1964.

Speyeria aphrodite alcestis (Edwards): Hyde Park Corner, July 16 and 21, 1909; new for Canada.

Two other remarkable records, noted by Bethune, are: *Melitaea gorgone* (Hübner) from Toronto and *Callophrys* (*Mitoura*) *gryneus* (Hübner) from Point Pelee. The first dates from 1891 on the Humber Plains, west of Toronto, where it was taken together with *Graphium marcellus* (Cramer) and *Colias* (*Zerene*) *cesonia* (Stoll): all three have not been taken again in the Toronto area. *C. gryneus*, however, was taken in 1963 in Hastings County. This area is north of Lake Ontario where the foodplant red cedar (*Juniperus virginiana*) is abundant (A. Holmes, *in litt.*). The specimens are deposited in the Royal Ontario Museum.

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REARING THE LARVAE OF *LONOMIA CYNIRA* (SATURNIIDAE)

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The genus *Lonomia* consists of six variable and often confusing species of Neotropical moths whose range extends north to Mexico. Dr. A. D. Blest (*personal communication*) reports that on Barro Colorado Island, Canal Zone, Panama, the larvae are found feeding on a species of *Quassia*. The early instar larvae rest on the under surface of the leaves, while the later instars are found resting in a tight group of 4 to 10 larvae on the trunks, some 18 inches to 4 feet from the ground, returning to the same place each day after feeding. When disturbed they fall to the ground and bury themselves in litter.

On September 5, 1961 I received by airmail 153 ova of *Lonomia cynira* Cramer, which had been laid by a female obtained in a light-trap operated by Dr. Blest at Barro Colorado. These eggs started to hatch after seven days and about 75 larvae emerged by the eighth day following receipt. No further emergence took place. Assuming that the eggs had been laid a week before receipt, a period of 14 days was required for the eggs to hatch, about average for a saturniid.

The natural foodplant being unknown, the larvae were offered a choice of *Robinia pseudo-acacia*; *Fagus sylvaticus*; *Ligustrum ovalifolium*; *Prunus* sp.; and *Ulmus campestris*. After 24 hours they had commenced to feed on the first of these trees and were maintained on this plant in small plastic boxes until the end of the third instar. The larvae were then transferred from the boxes to a well ventilated larval rearing cage 18″ × 12″ × 12″. By this time the *Robinia* leaves had yellowed and fallen and *Fagus* was again offered and was accepted. This food was continued until about half the larvae had pupated. The *Fagus* supply then also failed and the last of the larvae finished their development on a mixture of *Carpinus betulus* and *Quercus ilex*. The last half dozen larvae failed to pupate on this diet, but it is possible they might have failed in any case, as they were very much retarded.

The development times of the various larval instars, which were kept at 25°C. ± 5° was as follows: 1st instar, 7 days; 2nd instar, 5 days; 3rd instar, 6 days; 4th instar, 10 days; 5th instar, 9 days; 6th instar, variably from 18 to 44 days. The mean larval duration of the 40 which pupated

[1] This work was supported by the United States National Institutes of Health, Project No. GM-07109.

Fig. 1. Mature larva of *Lonomia cynira* Cramer, dorsal aspect.

was 68 days. The pupae were used for physiological experiments and it was not therefore possible to determine the duration of this stage or to obtain pairings and so complete the life-cycle.

When small the larvae are gregarious. When large they still retain this habit when resting, but scatter widely when feeding. The larvae fed only at night and during the day rested in a cluster off the food-plant. Beginning with the fourth instar the larvae sought shelter underneath the paper with which the floor of their cage was lined. There was a tendency for the larvae to drop and wriggle violently when disturbed. After a few seconds of this behaviour they would rapidly crawl away. This species is the most active saturniid larva I know and is equal in speed to some of the better known Arctiid larvae, such as *Spilosoma lubricipeda* (Linnaeus).

The first pupae were found on the floor of the cage underneath some lining paper. A layer of peat, overlaid by a thin covering of moss was then supplied. All subsequent pupae were found naked on the top of the peat. No trace of a cocoon was found, nor did the larvae appear to spin silk at any stage.

Egg. Distinctly box-like (rather than ovoid or spherical), 1.5 mm × 1.1 mm × 2.0 mm high. When received, varying from pale to dark green, with a 1.0 mm

wide whitish band completely encircling each egg. Micropyle minute, almost invisible.

First instar larva. No description was made. A few specimens preserved in alcohol were sent to Yale University.

Final instar larva. Length about 3.75 cm, thickest at middle, tapering toward each extremity. Ground color brownish-black, overlaid by a series of lighter longitudinal lines, edged with black; each segment with up to six chalazae each bearing rather short, sparse urticaceous spines brown to black. Dorsum of thoracic segments with a conspicuous white mark with black-ringed brownish centre (see Figure 1), characteristic beginning with the second instar.

The author's skin did not react strongly to the 'sting' of this larva; the 'sting' being about equal to that of an *Automeris io* Fabricius.

NEW SOCIETY AND NEW JOURNAL

With the publication of its first issue in November, 1966, a new journal has begun: the *Newsletter of the Association of Minnesota Entomologists.* The Association and its *Newsletter* are primarily concerned with Minnesota entomology (especially Lepidoptera), but they welcome members from anywhere, and articles on any aspect of entomology and any part of the world.

The *Newsletter*, under the editorship of John H. Masters, is printed by silk-screen mimeograph and appears (quarterly) in an octavo format with a card cover enclosing 24 pages. The first number has the following contents: constitution and by-laws; publication announcements; the Rhopalocera of Minnesota, Part I Hesperiidae Hesperiinae (by R. L. Huber); Rhopalocera of Fort Snelling (by J. T. Sorensen); Minnesota life zone map; the Coleoptera of Minnesota, Part I Cicindelidae (by R. L. Huber). There is also a Field Collectors' Section (this one includes an account of a collecting trip to the Black Hills and of an encounter with an *Agrias* in Venezuela), and an exchange column.

The prime-movers of the new organization, John H. Masters, John T. Sorensen, Ronald L. Huber and Patrick J. Conway among them, are enthusiastic and capable. Wisely they have chosen to begin modestly. The low cost of membership (which includes subscription to the *Newsletter*) should encourage many lepidopterists, both amateur and professional, both in and out of Minnesota, to join and thus provide moral and financial support to a budding concern.

There are two classes of paying membership: *active* members ($2.00 a year) have voting privileges; *corresponding* members ($1.00 a year) do not. Both receive the *Newsletter.* Membership applications should be addressed to the secretary-treasurer, Patrick J. Conway, Apt. 306, 7544 Cedar Avenue South, Richfield, Minnesota 55423. Editorial correspondence should go to John H. Masters, P. O. Box 7511, St. Paul, Minnesota 55119.—HARRY K. CLENCH, *Carnegie Museum, Pittsburgh, Pennsylvania 15213.*

FURTHER DISTRIBUTION RECORDS AND TAXONOMIC NOTES ON *PHILOTES RITA* (LYCAENIDAE)

Harry K. Clench
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The recent revision of the little known species, *Philotes rita* (Barnes & McDunnough), by Mattoni (1966) makes it desirable to publish the following new records.

Philotes rita rita (Barnes & McDunnough)

New Mexico: Silver City [Grant Co.], 13.viii.1913, *leg.* J. B. Wallis, 1 ♂, Carnegie Mus., *ex* Acad. Nat. Sci., Philadelphia (♂ gen., slide C-1025).

This is the first record of the species for New Mexico. The single specimen agrees with nominate *rita* except that the macules of the postmedian row of the hindwing below from M_1 to 2A are very small. It is possibly only an individual variant.

Mattoni (1966: 86) cited the locality, "Rio Verde Mountains," from the original description of *rita* and added that he was unable to locate the mountains but believed the name to be an older one for the Huachucas. Two specimens of *rita* in Carnegie Museum are from this locality (probably the same lot as the *rita* paratype mentioned by Mattoni), and their labels shed light on the question. They read: "Rio Verde Mts., Phoenix, Arizona, Aug. 1893, W. Barnes." The mountains, presumably, are northeast of Phoenix, near the Verde River, a locality about halfway between the two pairs of Arizona stations shown on Mattoni's map.

Philotes rita subspecies

Nevada: "Montello Wells" [at or near Montello, Elko Co. ?], 8.viii.1948, *leg.* E. R. Tinkham, 1 ♂, Carnegie Mus. (♂ gen., slide C-1023).

This specimen appears to represent an undescribed subspecies. In the sum of its characters it is closest to *pallescens*, not surprising considering geographic proximity; but it differs from *pallescens* in the darker blue, the heavier fuscous borders, and the presence of an aurora on the hind wing. All three characters give the upperside a striking resemblance to the figure of *r. rita* in Tilden & Downey (1955: 28, fig. 1). It also differs from *pallescens* in the larger, distinctly quadrate discal and postmedian spots of the fore wing underside. The latter character suggests a relationship to *elvirae* Mattoni from California. The male genitalia are very similar to those of *pallescens* (Tilden & Downey, 1955: 27, fig. 1).

Mattoni's view that all four forms (*rita, pallescens, coloradensis* and *elvirae*) are conspecific has much to recommend it: mutual allopatry, similar ecology, similar flight period. He mentions, but does not emphasize that the differentiation among these forms is not equal. They can be grouped in two assemblages: (1) the *rita* group of subspecies, including *rita* and *coloradensis*; and (2) the *pallescens* group of subspecies, including *pallescens*, the unnamed subspecies above and *elvirae*. These two groups are well defined by multiple genitalic characters (Tilden & Downey, 1955; Mattoni, 1966) and alar characters (especially the aurora on the hindwing underside which is large and thick in the *rita* group, smaller and quite thin in the *pallescens* group). Although there is no point in taking such a step now, I believe that future discoveries may make advisable an elevation of *pallescens* to specific rank, with its own coterie of races distinct from those of *rita*. This does not imply that I think *rita* and *pallescens* necessarily will be found to occur sympatrically.

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Book Notice

INSECT PESTS by George S. Fichter, edited by Herbert H. Zim, illustrated by Nicholas Strekalovsky, was published in the Golden Nature Guide Series in 1966, price $1.00. It contains illustrations in color and useful information on 67 species of butterflies and moths, some of which is not as readily available elsewhere. The species of Lepidoptera covered are tabulated below in the order in which they are included in generally followed lists.

Papilionidae: *Papilio polyxenes asterius* (black swallowtail, celery worm) p. 83. Pieridae: *Pieris rapae* (imported cabbageworm) pp. 13, 80; *Colias eurytheme* (alfalfa caterpillar) p. 115. Sphingidae: *Protoparce sexta* (Carolina sphinx, tobacco hornworm) pp. 13, 15, 113; *Protoparce quinquemaculata* (tomato hornworm) p. 82. Arctiidae: *Isia isabella* (banded woolybear) p. 83. Noctuidae: *Agrotis orthogonia* (pale cutworm) p. 64, *Agrotis ipsilon* (black cutworm) p. 64, *Peridroma saucia* (variegated cutworm) p. 64, *Amathes c-nigrum* (spotted cutworm) p. 64, *Pseudaletia unipuncta* (armyworm) pp. 11, 110; *Lithophane antennata* (green fruitworm) p. 124, *Papaipema purpurfascia* (columbine borer) p. 93, *Papaipema nebris* (stalk borer) p. 114, *Laphygma frugiperda* (fall armyworm) p. 110, *Heliothis zea* (corn earworm, bollworm) p. 109, *Trichoplusia ni* (cabbage looper) p. 80, *Alabama argillacea* (cotton leafworm) p. 108. Dioptidae: *Phryganidia californica* (California oakworm) p. 144. Liparidae: *Hemerocampa leucostigma* (white marked tussock moth) p. 143, *Porthetria dispar* (gypsy moth) p. 142, *Nygmia phaeorrhoea* (brown tail moth) p. 143. Lasiocampidae: *Malacosoma americana* (eastern tent caterpillar) p. 143, *Malacosoma disstria* (forest tent caterpillar) p. 143. Geometridae: *Alsophila pometaria* (fall cankerworm) p. 121, *Paleacrita vernata* (spring cankerworm) p. 121. Limacodidae: *Sibine stimulea* (saddleback caterpillar) p. 47, *Phobetron pithecium* (hag moth caterpillar) p. 47. Megalopygidae: *Megalopyge opercularis* (puss caterpillar) p. 47. Pyralidae: *Diaphania nitidalis* (pickleworm) p. 81, *Diaphania hyalinata* (melonworm) p. 81, *Loxostege similalis* (garden webworm) p. 82, *Loxostege sticticalis* (beet webworm) p. 82, *Udea rubigalis* (celery leaftier) p. 83, *Pyrausta nubilalis* (European cornborer) p. 112, *Crambus caliginosellus* (corn root webworm) p. 115, *Diatraea crambidoides* (southern corn stalk borer) p. 114, *Elasmopalpus lignosellus* (lesser corn stalk borer) p. 114, *Anagasta kuhniella* (Mediterranean flour moth) p. 149, *Ephestia elutella* (tobacco moth) p. 151, *Plodia interpunctella* (Indian meal moth) p. 149. Tortricidae: *Spilonota ocellana* (eye-spotted bud moth) p. 121, *Grapholitha molesta* (Oriental fruit moth) p. 123, *Grapholitha packardi* (cherry fruit worm) p. 124, *Grapholitha interstictana* (clover head caterpillar) p. 115, *Carpocapsa pomonella* (codling moth) p. 120; *Archips argyrospilus* (fruit-tree leaf-roller) p. 124, *A. rosaceanus* (oblique-banded leaf-roller) p. 93, *Choristoneura fumiferana* (spruce budworm) p. 142, *Argyrotaenia velutinana* (red-banded leaf-roller) p. 93. Cossidae: *Prionoxystus robiniae* (carpenter worm) p. 144. Gelechiidae: *Sitotroga cerealella* (Angoumois grain moth) p. 148, *Pectinophora gossypiella* (pink bollworm) p. 108, *Gnorimoschema operculella* (potato tuberworm) p. 82, *Anarsia lineatella* (peach twig borer) p. 123. Aegeriidae: *Sanninoidea exitiosa* (peach tree borer) p. 122, *Synanthedon pictipes* (lesser peach tree borer) p. 122, *Podosesia syringae* (lilac borer) p. 93, *Melittia curcurbitae* (squash vine borer) p. 81. Plutellidae: *Plutella maculipennis* (diamond back moth) p. 80. Yponomeutidae: *Argyresthia thuiella* (arborvitae leaf miner) p. 92. Coleophoridae: *Coleophora caryaefoliella* (pecan cigar case bearer) p. 144. Gracillariidae: *Gracillaria azaleella* (azalea leaf miner) p. 92. Psychidae: *Thyridopteryx ephemeraeformis* (bagworm) p. 94. Tineidae: *Tinea pellionella* (case-making clothes moth) p. 31, *Tineola bisselliella* (webbing clothes moth) p. 31, *Tineola walsinghami* (plaster bagworm) p. 31.

In addition to finding illustrations and information about 67 species of Lepidoptera, the lepidopterist will note that only 67 of the more than 350 pests described are

Lepidoptera and that only three are butterflies. Twenty-one families of moths are represented: there are 12 of the noctuids and the pyralids; 9 tortricids; 4 each of gelechiids and aegeriids; 3 liparids and 3 tineids; 2 each sphingids, lasiocampids, geometrids, limacodids; and only one each of the remaining: arctiid, dioptid, megalopygid, cossid, plutellid, yponomeutid, coleophorid, gracillariid, and psychid. However, in the case of the Dioptidae, 100% of the species recorded from the United States and Canada fall into the pest category.—BRYANT MATHER, *Jackson, Mississippi.*

BOOK NOTICE

INDEX LITTERATURAE ENTOMOLOGICAE, Serie II, vol. II/F–L/. By W. Derksen and U. Sheiding-Göllner. 678 pp. Published by the German Academy of Agricultural Sciences. Price 55,-MDN. 1966 [„1965"].

The "Index" contains all entomological papers published in the period of 1864–1900. The second volume includes the authors' names in alphabetical sequence from Fabani to Lyttkens. For more important authors general biographical dates are given. This monumental work will contain four volumes with the "Authors index" and one with the "General index." Both volumes, edited by the German Entomological Institute, have 1375 pages. Review of the first volume see: *Jour. Lepid. Soc.*, 19:62, 1965. The "Index" is very important for all students in entomology, especially in taxonomy, faunistics, zoogeography a.o.—JOSEF MOUCHA, *National Museum Prague, Praha 1-Czechoslovaki.*

THE LARVAE OF *CELERIO LINEATA* AS FOOD FOR INDIANS[1]

While reading the letters written by William Greenwood Wright to Herman Strecker of Reading, Pennsylvania, I came across one dated July 10, 1882, from San Bernardino, California, that interested and amused me. The pertinent part of the letter reads:

"The digger indians eat the larvae as a delicacy, when they are plenty. They are desert larvae, I guess native to Arizona or South as Mexico or Lower Cal. They live best in the hot sandy deserts where it is roasting hot & never a drop of water to drink. When botanizing, years ago, I have seen the larvae in incredible numbers great, horrid things, feeding on the abronia (The abronia greatly resembles in habit & in flower, the common garden Verbenas.) & tribes of indians going after them like people after huckleberries. They seize a large larva, pull off its head & giving the carcass a jerk, throw out the viscera and then string the empty body on strings & hang them about their necks still wriggling; or else throw the carcass into a basket or bag to take them home where they hold a feast of several days & the indians come from 100 miles on foot to where the worms are found, to participate in the feast, & to carry home bags full of the dried larvae as stock for future soups. All of which I have seen & know to be true, though incredible."

Wright took a few of the larvae home and raised them. They proved to be *Celerio lineata* (Fabr.), a Sphingid that is abundant throughout the desert and other parts of the Southwest as well as elsewhere. The above quotation is just as Wright wrote it. The letter is one of many from Wright to Strecker in the files of the Department of Entomology at the Field Museum in Chicago.—F. MARTIN BROWN, *Fountain Valley School, Colorado Springs, Colorado.*

[1] This note is a by-product of N.S.F. Grant GS-969 to preserve the Strecker papers.

NOTICE TO CONTRIBUTORS TO THE *JOURNAL*

Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11" paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal.* Legends of figures and tables should be submitted on separate sheets.

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In This Issue

BUTTERFLIES OF BRAZILIAN PLANALTO
MITES FROM NOCTUID MOTHS
TYPE LOCALITIES OF LYCAENIDAE
ARKANSAS BUTTERFLIES

(Complete contents on back cover)

21 August 1967

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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

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In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is Yale University, Peabody Museum, New Haven, Connecticut. Second class postage paid at Lawrence, Kansas, U. S. A.

Journal of The Lepidopterists' Society

Volume 21 1967 Number 3

LEPIDOPTERA OF THE CENTRAL BRAZIL PLATEAU. I. PRELIMINARY LIST OF RHOPALOCERA (CONTINUED): LYCAENIDAE, PIERIDAE, PAPILIONIDAE, HESPERIIDAE

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An introductory account of physiographic features of the central Brazil Plateau, or planalto, the collections involved, and a list of Nymphalidae and Libytheidae has been given in the first part of this series (Jour. Lepid. Soc., 21: 77).

Lycaenidae

Riodininae

The following list is arranged according to Stichel (1930), with order modified according to Clench (1955). Determinations are by the authors, where necessary in relation to original descriptions. Where determinations still remain unsure they are marked (?).

Almost all riodinids are intensely local, absent from many apparently suitable areas while common in a given small preferred location. Furthermore, many species have a specific flight time correlated with sun and temperature (probably not with the clock), as indicated below under the separate species.

201. *Hamearis campestris* (Bates, 1868).
SobrdW 1♂ 22-II-66, 1♂ 10-VI-66; Contagem c 15, 17-VIII-65; Maranhão 1♀ 14-VIII-65, c 12-VI-66; JZool 1♀ 26-I-62, 1♀ 27-I-62, c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; PGama 1♂ 9-VI-66; Anap 1♂ XI-36; Camp 1♂ III-30; Leop 6♂ 2♀ III-38; Vian 5♂ 2♀ III-30, 1♂ XI-31; K222 3♂ 20-II-66; PPEflex 1s 19-II-66, c 7-VI-66; PPW 1s 19-II-66, c 6, 7-VI-66. Flies all day, in open fields and especially attracted to small flowers.
202. *Hamearis epulus* (Cr., 1775).
JZool 1♂ 8-VI-66 (KB); Camp 2♂ XII-37; Vian 4♂ III-30; Arag 1♂ II-30. Habits similar to those of *campestris*.
203. *Hamearis colchis* (Feld., 1865).

Camp 1♂ XII-37.

204. *Hamearis middletoni* (Sharpe, 1890).
Leop 1♀ X-37.

205. *Hamearis theodora* (Godm., 1903).
Leop 1♂ XI-37; Vian 1♀ IV-30.

206. *Euselasia mys cytis* Stich., 1919.
Sobrd 1♂s 24-II-66, 1♂ 10-VI-66; Contagem 5♂ 17-VIII-65; Fercal 1♂ 25-II-66; Maranhão 1♂ 15-VIII-65; BrasCC 1♂ 11-VI-66; PGama 3♂ 9-VI-66; Vead 1♂; Leop 1♂ XII-37; Vian 1♂ III-30, 1♂ III-38. Flies with the first sun, around favored bushes warmed by it, within the forest or along paths.

207. *Perophthalma tullius tullius* (F., 1787).
K222 1♂ + 1s 20-II-66 (OM). Flies in morning.

208. *Leucochimona philemon mathata* (Hew., 1873).*
SobrdW 1♀ 22-II-66, 2s 10-VI-66; Maranhão 1♂ 14-VIII-65; JZool 1♂ 21-II-66; PGama c 9-VI-66; Camp 2♂ I-38; K485 1♂ 26-II-66; K222 3♂ 20-II-66. Rather general in woods; flies at mid-day.

209. *Mesosemia sirenia nitida* Stich., 1923.
Anap 1♀ XII-35, 1♂ I-36.

210. *Mesosemia rhodia* (Godt., 1824).*
SobrdW 3♂ 2♀ 22-II-66, 2♂ 24-II-66, 2♂ 10-VI-66; Leop 1♂ XII-37; Vian 1♂ 1♀ III-30. Flies in early afternoon.

211. *Mesosemia maeotis* Hew., 1859.
Maranhão 1♂ 12-VI-66 (KB); PGama 2♂ 2♀ 9-VI-66 (KB); Vian 1♂ 1♀ III-30. Females fly in early morning, males mid-afternoon (as is the case with many riodinids).

212. *Mesosemia melpia* Hew., 1859. (?)
PGama 1♂ 9-VI-66 (KB). Mid-day.

213. *Mesosemia levis* Stich., 1915. (?)
SobrdW 1♂ 22-II-66 (KB), 1♀ 24-II-66 (KB). Flies in afternoon.

214. *Mesosemia* sp.
Maranhão 1♂ 14-VIII-65; JZool 1♀ 8-VI-66. Small, very dark; related to the two previous species but not equal to either of them.

215. *Mesosemia* sp.
SobrdW 2♂ 10-VI-66 (KB). Large, olive-green.

216. *Eurybia dardus misellivestis* Stich., 1910.*
SobrdW 1♂ 24-II-66; JZool 1♂ 27-I-62, 1♂ 21-II-66; K222 c 20-II-66; PPEflex 2♂ 27-II-66, 1♂ 6-VI-66. Flies from early morning to mid-day.

217. *Eurybia nicaea paulla* Stich., 1926.
Camp 2♂ III-30, 10♂ 4♀ I-38; Leop 1♂ XII-37, 1♂ 2♀ III-38.

218. *Eurybia elvina tephrias* Stich., 1915.*
Contagem 1♂ 23-II-66; Fercal 1♂ 25-II-66; Maranhão 1♂ 15-VIII-65; JZool 4♂ 21-II-66, 1♂ 8-VI-66; Goiânia 3♂ 30-I-62; PPW 2♂ 27-II-66. Flies from morning to mid-day.

219. *Alesa prema* (Godt., 1824).
Maranhão 1♀ 14-VIII-65 (KB). Flies in morning.

220. *Cremna thasus* (Stoll, 1780).
SobrdW 1♀ 10-VI-66 (KB); JZool 1♂ 21-II-66 (OM); Leop 1♀ XII-37; Vian 1♀ III-30. Flies at mid-day.

221. *Cremna actoris cuyabaensis* Talbot, 1928.
Maranhão 1♂ 12-VI-66 (KB); Camp 1♀ I-38. Flies in afternoon.

222. *Lyropteryx apollonia apollonia* Westw., 1851.
Vead 1♂.

223. *Lyropteryx terpsichore terpsichore* Westw., 1851.
SobrdW 1♂ 13-VIII-65, 1♂ 24-II-66, 1♂ 10-VI-66; JZool 1♀ 1960, 1♂ 12-IV-63, 1♀ 18-IV-63; BrasCC 1s 11-VI-66; Camp 1♂ I-38; Leop 1♂ X-37,

4♂ XII-37; Vian 1♂ XII-30, 2♂ XI-31. Flies in morning, often visiting flowers; in late afternoon, around trees in cerrado.

224. *Ancyluris colubra colubra* (Saunders, 1859).
SobrdR 1♀ 11-VIII-65, 1♀ 12-VIII-65, 1♀ 13-VIII-65; Maranhão 1♂ 12-VI-66; JZool 3♂ 8-VI-66; Vead 2♂. Flies in early morning; sometimes taken at wet sand.

225. *Rhetus arcius amycus* Stich., 1909.*
Anap 1♂ XI-36. Flies in very early morning.

226. *Rhetus arthurianus* (Sharpe, 1890).
SobrdW 2♂ 24-II-66; Fercal 1♂ 23-II-66, 1♂ 25-II-66; Vead 1♂; PPW 1♀ 27-II-66 (OM); Go 1♂. Flies from morning to mid-day; visits wet sand, flowers. Seems to replace *A. colubra* in similar habitat in summer.

227. *Chorinea amazon* (Saunders, 1858).
JZool 1♂ 21-II-66 (KB). Flies at mid-day.

228. *Panara thisbe* subsp.
SobrdW 1s 22-II-66, 2♂ 24-II-66, 1♂ 10-VI-66; Contagem 1♂ 23-II-66; Vian 1♂ 2♀ III-30. Flies at mid-day. Hindwing yellow band nearly parallel submarginal; figured in Seitz (1930: 46).

229. *Brachyglenis drymo* (Godm. & Salv., 1886).*
SobrdW 1♂ + 1s 24-II-66 (OM). Flies at mid-day.

230. *Notheme eumeus agathon*, "form" *hemicosmeta* Stich., 1910.
Vead 1♂; Camp 2♂ I-38; Leop 2♂ XII-37. The constant form in the planalto, perhaps warranting subspecific status. Flies in early morning.

231. *Monethe alphonsus* (F., 1793).*
Maranhão 1♂ 12-VI-66 (KB); Vead 1♂. Flies in morning; visits wet sand.

232. *Metacharis cuparina* Bates, 1868.
Leop 5♂ III-35.

233. *Metacharis lucius* (F., 1793).
Vian 3♂ III-30.

234. *Lepricornis teras* Stich., 1910.
Maranhão 1♂ 14-VIII-65; JZool 1♂ 26-I-62; PPEflex c 19-II-66. Active in early morning, often at flowers.

235. *Lepricornis atricolor atricolor* Butl., 1871.
SobrdR 1s 11-VIII-65, 1♂ 12-VIII-65; JZool 2♂ 21-II-66; Camp 1♀ III-30; PPEflex 2s 19-II-66. Flies in early morning, often taken at flowers.

236. *Barbicornis melanops* Butl., 1873.*
PPW 1♂ 27-II-66 (OM). Flies in morning.
All the species of *Barbicornis* listed here occur sympatrically and may well be all forms of the same species; the genus is in need of a revision. This individual has a short white forewing band and no light margin on the hindwing.

237. *Barbicornis mona* Westw., 1851.*
Typical form: Camp 1♂ 1♀ III-30. Form with short, almost round yellow forewing spot; complete hindwing margin: Vead 1♂ (PG); Tag 2♂ (PG); PPEflex 1♂ 19-II-66; PPW 3♂ 19-II-66, c 27-II-66. Flies in morning. Form with white, short forewing spot and hindwing margin: Vead 1♂ (PG).

238. *Barbicornis marginata* Seitz, 1917.
Fercal 1♂ 23-II-66, 2♂ 1♀ 25-II-66. Flies in morning. Possibly another form of *mona*, with yellow apical spot on forewing, hindwing margin.

239. *Syrmatia dorilas* (Cr., 1775).
Camp 1♂ III-30. Flies with first sun in early morning. This specimen has a rather reduced white forewing spot.

240. *Chamaelymnas doryphora* Stich., 1910.*
Fercal 1♂ 23-II-66; Camp 5♂ III-30, 11♂ 2♀ I-38; Vian 1♂ 1♀ III-30, 1♂ XI-31. Flies in early afternoon. Amount of yellow markings rather variable.

241. *Chamaelymnas pansa* Godm., 1903.
PPW 2♂ 27-II-66, 1♂ 6-VI-66. Flies at mid-day.

242. *Chamaelymnas tircis* Feld., 1865.
Camp 10♂ 1♀ I-38. Forewing bar broader than in *pansa*, yellow in females.
243. *Calephelis nilus* (Feld., 1861).
SobrdR 1♂ 11-VIII-65, 1s 22-II-66; SobrdW 1♂ 10-VI-66; Fercal c 15-VIII-65; Maranhão 1s 12-VI-66; JZool 2♂ 8-VI-66; PGama 2♂ 9-VI-66; Tag 1♂; Leop 1♂ III-38; Vian 3♀ III-30; K485 1♂ 26-II-66; PPEflex 1♂ 19-II-66; PPW 2s 27-II-66. Less local than most riodinids, flies all day.
244. *Parcella amarynthina monogramma* (Feld., 1865).
Vead 1♂; Camp 1♂ 1♀ I-38; Leop 3♂ XII-37; Vian 1♂ III-30.
245. *Charmona caryatis* (Hew., 1866).
SobrdW a 22, 24-II-66, c 10-VI-66; Contagem 1♂ 23-II-66; PGama c 9-VI-66; Camp 2♂ 1♀ I-38; Vian 2♂ III-30, 4♂ 1♀ IV-30, 6♂ XI-31; K485 c 26-II-66; K222 4♂ 20-II-66; PPW c 19, 27-II-66. Flies all day in sunny patches within the forest.
246. *Charmona gynaea zama* (Bates, 1868).
SobrdW 1♂ 22-II-66, 2♂ 1♀ 24-II-66; PGama 1♂s 9-VI-66; Vian 6♂ 6♀ III-30, 7♂ 1♀ IV-30, 1♀ XI-31, 1♀ XII-31, 1♂ I-38. Habits similar to those of *caryatis*.
247. *Chalodeta theodora theodora* (Feld., 1862).
SobrdR 1♂ 12-VIII-65, 1♂ 13-VIII-65; Maranhão 1♂s 15-VIII-65; BrasCC 1♀s 11-VI-66; Vead 2♂ 1♀; Camp 1♂ III-30; Leop 1♂ XI-37, 1♀ XII-37; K485 1♀ 22-VIII-65, 2♂ 26-II-66; PPEflex 1♂ 19-II-66, 1♂ 6-VI-66. Flies in morning to mid-day; often visiting wet sand.
248. *Chalodeta epijessa calicene* (Hew., 1866). *
PPEflex 2♀ 7-VI-66. Females fly in morning, males only afternoon.
249. *Baeotis johannae johannae* Sharpe, 1890.*
JZool 1♀ 27-I-62; K485 2♂ 22-VIII-65. Flies at mid-day.
250. *Lasaia meris arsis* (Stgr., 1888).*
Tag 1♂; Go 1♂. Flies in early morning.
251. *Lasaia agesilas agesilas* (Latr., 1805).*
SobrdR 1♀ 13-VIII-65 (KB); Vead 3♂; Cav 1♂; Camp 3♂ I-38; Leop 4♂ XII-37; Vian 1♂ II-30. Flies in early morning.
252. *Lasaia oileus* Godm., 1903.
Contagem 1♀ 17-VIII-65 (KB).
253. *Amarynthis meneria* (Cr., 1776).
Anap 1♂ 22-XII-35, 1♂ 25-XII-35, 1♂ XII-35; Camp 3♂ I-38.
254. *Riodina lycisca* (Hew., 1847).*
Contagem 2♂ 18-VIII-65; Maranhão 1♀ 14-VIII-65; PPW 1♂ 19-II-66. Flies in early morning. Form with light markings much reduced: Tag 2♂; Camp 3♂ I-38; Leop 1♂ XI-37; Vian 1♂ IV-30.
255. *Lymnas smithiae* (Westw., 1851).*
Deep orange markings: Vead 2♂. Form with lighter yellow-orange markings: PGama 3♂ 9-VI-66, Vead 2♂.
256. *Lymnas albugo albugo* Stich., 1910.*
Fercal 1♂ 17-VIII-65; Vead 1♂; Vian 1♂ III-30; PPW 1♂ 27-II-66. Form *impura* Stich., 1910: Fercal 1♂ 17-VIII-65, 1♂ 25-II-66. Forewing band yellowish. Both forms fly at mid-day.
257. *Lymnas iarbas auriferax* Stich., 1910.*
Maranhão 1♂ 12-VI-66; PPEflex 1♂ 19-II-66, 1♂ 7-VI-66; PPW 3♂ 19-II-66, 3♂ 27-II-66, c 6-VI-66. Form with forewing band white: PPEflex 1♂ 7-VI-66. Active at mid-day, or in morning on flowers.
258. *Lymnas marathon stenotaenia* (Röber, 1893). (?)*
Fercal 1♂ 1♀ 17-VIII-65, 1♂ 18-VIII-65, 2♂ 23-II-66, 3♂ 2♀ 25-II-66; Maranhão 1♂ 15-VIII-65. Flies at mid-day.
259. *Lymnas xenia erythra* (Mén., 1855).*

Contagem 1♂ 23-II-66; Fercal 1♂ 18-VIII-65; PPEflex 1♂ 6-VI-66; PPW 1♂ 27-II-66. Flies at mid-day.

260. *Mesene pyrippe* Hew., 1874.*
Maranhão 1♂ 14-VIII-65, 2♂ 15-VIII-65; PPEflex 1s 19-II-66. Flies during late afternoon.

261. *Mesene epalia* (Godt., 1824). (?)*
Maranhão 1♂ 15-VIII-65 (KB). Flies in late afternoon.

262. *Mesene hya monostigma* (Erichson, 1851).
Maranhão 1♂ 15-VIII-65 (KB). Active during late afternoon.

263. *Symmachia leopardina hilaria* (Hew., 1867).
SobrdW 1♀ 11-VIII-65, 1♂ 2♀ 22-II-66, 1♂ 1♀ + 4♂s 24-II-66, 2♂ + 1♂s 10-VI-66. Flies in afternoon.

264. *Phaenochitonia cingulis* (Stoll, 1791).
Leop 1♀ X-37; Vian 1♀ III-30; K485 1♂ 26-II-66 (KB). Active in the morning.

265. *Phaenochitonia sagaris satnius* (Dalm., 1823).
SobrdW 1♂ 12-VIII-65, 1♀ 13-VIII-65, 1♂ 22-II-66, 1♂ 24-II-66, 1♂s 10-VI-66; Contagem 1♀ 15-VIII-65; Vian 1♂ III-30. Flies during afternoon.

266. *Phaenochitonia bocchoris bocchoris* (Hew., 1876).*
SobrdR c 11, 12, 13-VIII-65; JZool 1♂s 8-VI-66. Flies during afternoon, in marshes and open grassland.

267. *Anteros formosus formosus* (Cr., 1777). (?)
SobrdW 1♂ 24-II-66 (OM); Vian 2♂ III-30; Arag 1♂ II-30; Ponte Funda, Goiás (near Vian) 1♂ 1-III-63. Active at mid-day, around grassy areas.

268. *Emesis lucinda lucinda* (Cr., 1775).
Contagem 1♀ 23-II-66 (OM); Leop 1♂ XII-37; PPW 1♂ 27-II-66 (OM). Flies at mid-day.

269. *Emesis mandana* (Cr., 1780).
JZool 1♀ 5-II-62; Leop 1♂ XI-37 (PG).

270. *Emesis diogenia* Prittw., 1865.*
SobrdW 1♂ 13-VIII-65; PGama 1♂ 9-VI-66; Vead 2♂. Flies at mid-day.

271. *Emesis* sp.
SobrdW 1♂ 1♀ 10-VI-66 (KB). Related to the preceding two species.

272. *Emesis fatima* (Cr., 1780).
Leop 2♂ XII-37.

273. *Emesis tenedia* Feld., 1861.
SobrdW 1♂ 10-VI-66.

274. *Emesis ravidula* Stich., 1910.*
Leop 2♂ XII-37, 2♂ III-38.

275. *Emesis ocypore zelotes* Hew., 1872. (?)*
JZool 1♀ 8-VI-66; BrasCC 1♂s 11-VI-66; Vian 1♂ III-30. Active in the morning.

276. *Emesis cerea* (L., 1767).
Maranhão 1♂ 15-VIII-65 (KB); JZool 1♂ 2-II-62.

277. *Ematurgina axena* (Hew., 1875).*
Leop 1♀ XI-37, 7♂ 1♀ III-38, 16♂ 4♀ IV-38; Vian 2♂ III-30; Go 1♂. Variable orange markings; possibly separable into two species. See discussion in Seitz (1932: 238).

278. *Apodemia stalachtioides* (Butl., 1867).
SobrdW 1♂ 22-II-66 (OM); Parac 1♂ (MN).

279. *Apodemia paucipuncta* Spitz, 1930.
SobrdW 1♂ 10-VI-66; BrasCC c 11-VI-66; Leop 5♂ X-37, 2♂ 1♀ III-38; Arag 1♂ XII-31; PPEflex 2♂ 7-VI-66. Flies all day, in open grassland.

280. *Polystichtis lucianus pseudocrispus* (Westw., 1851).
Goiânia 1♀ 29-I-62, 1♂ 30-I-62; Camp 1♀ III-30; K222 2♂ 8-VIII-65 (KB). Active during morning.

281. *Anatole zygia epone* (Godt., 1824).*
PPW 2♀ 27-II-66. Flies in afternoon.
282. *Anatole glaphyra modesta* Mengel, 1902.
SobrdW 1♂ 22-II-66; JZool 2♂ 21-II-66; Camp 1♀ I-38; Leop 1♂ III-38; Vian 1♂ III-30; K222 1♀ 20-II-66. Flies at mid-day.
283. *Thysanota galena* (Bates, 1868).
Vead 1♂.
284. *Aricoris tutana* (Godt., 1824).
Camp 4♂ III-30; Leop 2♂ XI-37; Vian 1♀ XII-30; Arag 1♀ II-30, 1♂ XII-31. Primarily in grasslands, resembles *Euptychia* in flight habits.
285. *Juditha lamis lamis* (Stoll, 1780).
Fercal 1♂ 15-VIII-65 (KB).
286. *Nymula brennus brennus* Stich., 1910.
SobrdW 1♂ 22-II-66; JZool 1♂ 8-VI-66; Goiânia 1♀ 30-I-62; Leop 3♂ III-38; Ponte Funda, Goiás (Near Vian) 1♂ 1-III-63. Recognized by pointed forewing and general red-brown coloration. Active at mid-day to afternoon.
287. *Nymula calyce calyce* (Feld., 1862).
JZool 1♀s 8-VI-66; PGama 1♂ 9-VI-66; Camp 1♂ III-30; Vian 1♂ III-30. Similar to *brennus* but less red-brown, with more rounded wings.
288. *Nymula pelope* (Hbn., 1816).
Leop 2♂ XII-37; K485 1♂ 26-II-66 (KB). Characterized by red submarginal lines. Flies at mid-day.
289. *Nymula phillone* (Godt., 1824).*
SobrdR 1♂ 22-II-66 (OM); Arag 1♀ II-30. Active during morning.
290. *Nymula ethelinda ethelinda* (Hew., 1870).*
PPW 2♀ 27-II-66 (OM). Flies in afternoon.
291. *Nymphidium azanoides* Butl., 1867.
Cav 1♂; Leop 3♂ III-38.
292. *Nymphidium leucosia* (Hoffmannsegg, 1806).
SobrdW 1♂ 13-VIII-65, c 22, 24-II-66, c 10-VI-66; Contagem 1♂ 17-VIII-65; BrasCC c 11-VI-66; PGama c 9-VI-66; Camp 1♂ 1♀ I-38; Leop 1♂ XII-37; Vian 6♂ 1♀ III-30. Active during afternoon.
293. *Nymphidium lysimon epiplatea* Butl., 1867. (?)
PGama 1♂ 9-VI-66; Camp 1♂ III-30; Vian 1♀ III-30; K222 1♂ 8-VIII-65; PPW 1♂ 19-II-66, 1♂ 27-II-66, 1♂ 7-VI-66.
294. *Nymphidium chione* Bates, 1867. (?)
Maranhão 1♂ 15-VIII-65; Leop 1♂ XII-37, 1♀ III-38; PPEflex 1♂ 19-II-66; PPW 1♂ 6-VI-66.
295. *Stalachtis phlegia* (Cr., 1765).
SobrdW c 11, 12, 13-VIII-65, 2♂ 22-II-66; JZool 1♂ 1♀ 27-I-62, 1♀ 1-II-62, 4♂ 21-II-66, c 8-VI-66; BrasCC 1♂ 11-VI-66; PGama 1♂ 9-VI-66; Vead 3♂ 2♀; Cav 1♂; Tag 1♂; Anap 1♂ XII-35, 1♀ 25-IV-36; Goiânia 1♂ 30-I-62; Leop 5♂ 3♀ X-37; Vian 4♂ 5♀ III-30. Includes various named forms. Flies all day in open grassy areas.
296. *Theope pieridoides* (Feld., 1865).
Leop 1♂ XI-37.
297. *Theope eudocia acosma* Stich., 1910.
SobrdW 1♂ (KB) + 5s 24-II-66, 1♂ (KB) + 2s 10-VI-66. Usually flies in the afternoon.

The list of riodinids grows with every excursion or new collection examined and should eventually reach about 150 species. With presence of both southern and Amazonian forms, it is expected that dozens of species have yet to be discovered and recorded for the planalto.

PLEBEJINAE

298. *Leptotes cassius* (Cr., 1775).
SobrdW 1♂ 1♀ 10-VI-66; Fercal c 23-II-66; Maranhão c 12-VI-66; JZool 1♂ 17-IX-63; BrasCC c 11-VI-66; PGama 3s 9-VI-66; Camp 2♂ III-30; RClaro 1♂ 18-VIII-63; Vian 1♀ III-30; K485 c 26-II-66; K222 c 20-II-66; PPEflex c 7-VI-66; PPW c 6-VI-66.

299. *Hemiargus ceraunus zachaeina* (Butl., 1872).
SobrdW c 10-VI-66; Maranhão c 12-VI-66; JZool c 8-VI-66; BrasCC c 11-VI-66; Anap 1♂ XI-36; Vian 1♂ III-30; Arag 1♀; K485 c 26-II-66; PPEflex c 6-VI-66, a 7-VI-66; PPW c 6-VI-66.

300. *Everes tulliola* (Godm. & Salv., 1887).
JZool 1♂ 8-VI-66; BrasCC 1♂ 11-VI-66; Camp 1♂ III-30; Vian 1♂ III-30; PPEflex 1♂ 19-II-66; PPW c 7-VI-66. Most commonly found in marshy areas.

301. *Plebejus(?) cogina* (Schaus, 1902).
SobrdR 1♂ 12-VIII-65; Maranhão 1♂ 17-VIII-65, c 12-VI-66; JZool c 8-VI-66; Camp 1♂ III-30; Vian 1♂ III-30; PPW 1♀ 7-VI-66. A little-known species, partial to marshy areas.

We do not foresee the occurrence of further Plebejinae in the planalto, although the group is little enough collected that range extensions or even new species are to be expected in various parts of South America.

THECLINAE

The taxonomic status of the South American "Theclas" is chaotic. We have identified only the commonest and most obvious species, and even many of these must be regarded as uncertain. In an effort to begin the process of subdivision of the family, we have applied here a number of genus names proposed in the past and compiled by Comstock & Huntington (1958). In cases where these genera have been applied to close relatives of the species included in this list, we have taken the liberty of using them with a question mark (?). Precise generic assignments will have to await a complete rearrangement of the presently understood "groups" upon detailed morphological study. We present the genera here merely as a rough guide and leave all uncertain cases in "Thecla."

302. *Arcas imperialis* (Cr., 1775).
Maranhão 1♂ 17-VIII-65 (KB).

303. *"Thecla" batesii* Hew., 1865. (?)
Leop 1♂ III-33. An undescribed genus containing *batesii* and a number of closely related species is closely related to *Evenus*.

304. *Evenus regalis* (Cr., 1775).
Vead 1♂ 1♀. Often common in towns.

305. *Macusia satyroides* (Hew., 1867).
SobrdW 1♀ 22-II-66 (KB); Vead 1♀ (PG). We suspect that this represents a new species distinct from the type of the genus but lack sufficient material to resolve the question at present.

306. *Pseudolycaena marsyas* (L., 1758).
SobrdW 1♂s 23-II-66; JZool 1♂ 21-II-66; BrasCC 1♂ 11-VI-66; Vead 1♂; Camp 1♂ III-33 (PG); PPEflex 1♂ 6-VI-66; PPW 1♀s 6-VI-66.

307. *Mithras hemon* (Cr., 1775).
SobrdW 1♂ 12-VIII-65, 1♂ 13-VIII-65; JZool 1♀ 21-II-66; K485 1♂ 22-VIII-65.

308. *Mithras triquetra* Hew., 1865.
BrasCC 1 ♀ s 11-VI-66; PGama 1 ♀ 9-VI-66; Vian 1 ♂ XI-31; K485 c 22-VIII-65.
309. *Panthiades (Parrhasius) polibetes* (Cr., 1781).
JZool 1 ♂ 27-II-63.
310. *Panthiades (Parrhasius) orgia* (Hew., 1867).
Vead 1 ♂ (PG).
311. *Atlides dydimaon* (Cr., 1777).
K222 1 ♂ 20-II-66 (KB).
312. *Cycnus phaleros* (L., 1766).
SobrdW 1 ♀ 22-II-66 (OM), 1 ♂ s 10-VI-66; Vian 1 ♂ III-30.
313. *Arawacus linus* (Sulzer, 1776).
SobrdW 1 ♀ 12-VIII-65, 1 ♀ 22-II-66; Fercal 1 ♂ 1 ♀ 17-VIII-65, 1 ♂ 18-VIII-65, 1 ♂ 23-II-66; Maranhão 1 ♂ 15-VIII-65; JZool 1 ♂ 27-I-62, 2 ♂ 1 ♀ 1-II-62, 2 ♂ 1 ♀ 20-II-63, c 21-II-66; PGama c 9-VI-66; Camp 1 ♀ III-33.
314. *Rekoa ellida* (Hew., 1867).
SobrdW 1 ♂ 11-VIII-65; JZool 1s 8-VI-66; PPW 1 ♂ 6-VI-66.
315. *Rekoa palegon* (Cr., 1780).
Fercal 1 ♂ 17-VIII-65, 1 ♀ 18-VIII-65; BrasCC 1 ♂ 11-VI-66; PGama 1 ♂ 9-VI-66; Vian 1 ♂ III-33 (PG); Parac 1 ♀ 4-III-21.
316. *Rekoa meton* (Cr., 1779).
SobrdW 1 ♀ 13-VIII-65; Maranhão 1 ♂ 15-VIII-65; JZool 1 ♀ 8-VI-66; BrasCC 1 ♂ 11-VI-66.
317. *Callophrys (Cyanophrys) (?) acaste* (Prittw., 1865).*
SobrdW 1 ♂ 11-VIII-65, 1 ♂ 12-VIII-65.
318. *Iaspis(?) violescens* (Spitz, 1931).
SobrdR 1 ♂ 12-VIII-65; SobrdW c 10-VI-66; PGama c 9-VI-66; Vian 1 ♂ III-30. A common endemic species of the planalto, easily recognized.
319. *"Thecla" ravus* Druce, 1907.
K485 1 ♂ 22-VIII-65 (KB).
320. *Chalybs jebus* (Godt., 1822).
Vian 1 ♂ III-30; PPEflex 1 ♀ 19-II-66.
321. *"Thecla" torris* Druce, 1907.*
Vian 1 ♂ XI-35.
322. *"Thecla" bagrada* Hew., 1868.
SobrdW 1 ♂ 1 ♀ 10-VI-66; Leop 1 ♂ III-33 (PG).
323. *"Thecla" obelus* Druce, 1907.
Vian 1 ♂ III-30.
324. *"Thecla" cauter* Druce, 1907.
SobrdW 1 ♂ 10-VI-66; Camp 1 ♀ III-33 (PG); Leop 2 ♂ III-33 (PG); Vian 3 ♂ XI-35 (PG); Arag 1 ♂ II-30.
325. *"Thecla" sophocles* (F., 1793).*
Maranhão 1 ♀ 15-VIII-65; PGama c 9-VI-66; Camp 1 ♂ III-33 (PG); Vian 3 ♀ XI-35 (PG); K485 1 ♂ 22-VIII-65. Males fly in sunny places in the forest in early to late afternoon.
326. *"Thecla" hebraeus cimelium* Gosse, 1880.*
JZool 1 ♀ 1-II-62, 1 ♂ 8-VI-66.
327. *"Thecla" quassa* Draudt, 1920.*
Vian 1 ♀ III-30.
328. *Tmolus cupentus* (Cr., 1781).
Fercal 1 ♂ 25-II-66.
329. *Tmolus venustus* (Druce, 1907).*
Vian 1 ♂ III-30, 4 ♂ 1 ♀ XI-35 (PG).
330. *Tmolus cydrara* (Hew., 1868).
Camp 2 ♂ III-30.
331. *Tmolus azuba* (Hew., 1874).

Camp 1♂ 1♀ (PG); Leop 1♂ III-33 (PG); Vian 1♀ XI-35 (PG); Arag 1♂ III-30.

332. *"Thecla" aepeona* Draudt, 1920. (?)
Vian 1♂ III-30.

333. *"Thecla" zurkvitzi* Schaus, 1902.*
Arag 1♀ II-30.

334. *"Thecla" aphaca* Hew., 1867.
SobrdW 1♀ 12-VIII-65; Vian 1♂ III-30.

335. *"Thecla" crambusa* Hew., 1874.
Vian 1♂ XI-31, 1♂ XII-31; PPW 1♂ 6-VI-66.

336. *"Thecla" cissusa* Hew., 1877.
Vian 1♂ III-30; Arag 1♂ II-30.

337. *"Thecla" chilica* Schaus, 1902.*
Vian 1♂ III-30.

338. *Calycopis beon* (Cr., 1780).
SobrdW 2♂ 10-VI-66; JZool c 8-VI-66; Vian 4♂ III-30; Arag 1♂ II-30; PPEflex c 19-II-66.

339. *Calycopis azia* Hew., 1873.
Fercal 1♂ 23-II-66; Leop 1♂ III-33, 1♂ 1♀ XI-37; Arag 3♂ 2♀ II-30.

340. *"Thecla" rufofusca* Hew., 1877.
Vian 1♂ IV-30.

341. *Callicista mulucha* Hew., 1874.
SobrdR 1♂ 22-II-66; SobrdW 2♂ 10-VI-66; JZool 1♀ 28-II-63; Vian 1♂ III-30; Parac 1♀ 9-II-21; PPW 1♂ 6-VI-66.

342. *Callicista faunalia* Hew., 1868.
SobrdW 1♂ 13-VIII-65 (KB).

343. *Callicista thius* (Hbn., 1832).
BrasCC 1♂ 11-VI-66.

344. *Callicista eurytulus* (Hbn., 1819).
Maranhão 1♂ 12-VI-66; JZool 3♂ 27-I-62; Vian 1♂ III-30, 1♀ XI-31; PPEflex 1♂ 6-VI-66, c 7-VI-66.

345. *"Thecla" tarania* Hew., 1868.*
Vian 3♂ XI-35 (PG).

346. *"Thecla" seitzi* Spitz, 1931.
Leop 2♂ 1♀ III-33 (PG), 1♂ 2♀ XI-37; Vian 2♂ 1♀ III-30, 1♀ XI-31; Arag 4♂ 2♀ II-30. May be a subspecies of *tegaea*.

347. *"Thecla" melzeri* Spitz, 1931.
Leop 7♂ 3♀ III-33 (PG), 1♂ 1♀ XI-37; Vian 1♀ XI-31, 1♀ XII-31, 3♂ 5♀ XI-35 (PG); Arag 7♂ 6♀ II-30, 1♂ XII-31. May be a subspecies of *mantica*.

348. *"Thecla" taunayi* Spitz, 1931.
JZool 1♂ 21-II-66; Camp 1♂ (PG); Leop 1♂ 1♀ III-33 (PG), 1♂ XI-37; Vian 1♂ 1♀ III-30, 1♂ 1♀ XI-35 (PG); Arag 1♂ 2♀ II-30.

With further determinations (and possibly descriptions of new species) as well as more diligent collecting in seasons of flowers, the list of Theclinae should nearly equal that of the Riodininae (about 150).

Total for Lycaenidae: 148 species. Predicted to occur on planalto: approximately 300 species; therefore about 50% represented on present list.

Pieridae

Coliadinae

We follow the recent revisions, as well as direct advice, of D'Almeida

(1936a, b; 1938a, b; 1939; 1940; 1944a, b; 1945; 1960) for the nomenclature in this group.

349. *Eurema (Pyrisitia) tenella* (Bdv., 1836).
SobrdW c 22, 24-II-66; Fercal c 23, 25-II-66; Maranhão c 12-VI-66; JZool 3♂ 27-I-62, 2♂ 20-II-63, c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; Vead 6♂; Cav 1♂; Tag 1♂; Arag 1♂ 2♀ II-30, 2♂ XII-31; Parac 2♂ 1♀ 20-II-19; K485 c 22-VIII-65, c 26-II-66; PPEflex 1♂ 19-II-66, c 7-VI-66.

350. *Eurema (Pyrisitia) leuce* (Bdv., 1836).
SobrdW c 11, 12-VIII-65, c 22, 24-II-66; Fercal c 23, 25-II-66; PGama 1♀ 9-VI-66; Vead 1♂; Cav 2♂; Goiânia 2♂ 30-I-62; Leop 6♂ 3♀ XII-36; K485 c 26-II-66; K222 c 20-II-66; PPEflex c 6, 7-VI-66; PPW c 6, 7-VI-66.

351. *Eurema (Eurema) pseudomorpha* Klots, 1929.
Maranhão 1♂ 15-VIII-65; Vead 1♂; Cav 1♂; K485 1♂ 22-VIII-65, 1♂ 26-II-66. Generally larger than all central Brazilian *Eurema* except extraordinary females of *E. leuce*, and distinguished by characteristic hindwing underside pattern.

352. *Eurema (Eurema) deva* (Dbldy., 1847).
Maranhão 1♂ 15-VIII-65, 1♀ 12-VI-66; JZool 2s 8-VIII-66; Camp 1♂ 8-III-31 (OC).

353. *Eurema (Eurema) arbela arbela* (Geyer, 1832).
Fercal 1♂ 23-II-66; Maranhão 1♂ 15-VIII-65; JZool 2♂ 27-I-62, 1♂ 1-II-62, 1♀ 21-II-66, c 8-VI-66; BrasCC 1s 11-VI-66; PPEflex 1♂ 19-II-66, 3s 7-VI-66; PPW 1♂ 19-II-66, c 27-II-66, c 6, 7-VI-66.

354. *Eurema (Eurema) musa* (F., 1793).
Fercal 1♂ 17-VIII-65, 1♂ 18-VIII-65. Replaces *phiale* in the same areas in winter, and may be a winter form of the following species.

355. *Eurema (Eurema) phiale flavomaculata* d'Alm., 1958.
Fercal c 23-II-66; Anap 1♂ I-36, 1♀ 20-III-36.

356. *Eurema (Eurema) phiale majorina* d'Alm., 1932.*
Parac 1♀ 9-II-21; K222 1♂ 20-II-66.

357. *Eurema (Eurema) agave pallida* (Chav., 1849).*
BrasCC 1♀ 11-VI-66; PPEflex 2♂ 19-II-66, 1♂ 6-VI-66, c 7-VI-66; PPW c 27-II-66, a 7-VI-66. Found particularly in marshes. Distinguished from following species by dark area at base of upperside forewing costa.

358. *Eurema (Eurema) albula* (Cr., 1775).
SobrdR 1♂ 12-VIII-65; SobrdW c 22, 24-II-66, c 10-VI-66; Contagem c 23-II-66; Fercal 1♂ 17-VIII-65, c 23, 25-II-66; Maranhão c 15-VIII-65, c 12-VI-66; JZool 1♂ 27-I-62, c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 1♂; Cav 3♂; Parac 1♂ 20-II-19; K485 c 22-VIII-65, c 26-II-66; K222 2♂ 8-VIII-66, c 20-II-66; PPEflex c 19, 27-II-66; PPW c 19, 27-II-66, c 6, 7-VI-66. One of the commonest butterflies of the planalto.

359. *Eurema (Eurema) elathea elathea* (Cr., 1777).
SobrdW c 11-VIII-65; Fercal c 23, 25-II-66; Maranhão c 14, 17-VIII-65, c 12-VI-66; JZool 1s 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; Vead 3♂; Cav 1♂; Tag 3♂; Camp 1♂ III-30; Arag 1♂ II-30; PPEflex c 19-II-66, c 7-VI-66; PPW c 27-II-66, c 6, 7-VI-66. Usually common, in open areas.

360. *Phoebis (Aphrissa) statira* (Cr., 1777).
SobrdW 1♂ 1♀ 11-VIII-65, 1♀s 24-II-66, 5s 10-VI-66; Contagem 1♀ 23-II-66; Fercal c 23, 25-II-66; Maranhão c 15, 18-VIII-65; Vead 1♀; Tag 1♂; Anap 1♂ XII-36; PPW c 27-II-66, 2s 7-VI-66; Go 1♂.

361. *Phoebis (Phoebis) neocypris* (Hbn., 1823).
Fercal 1♂ 17-VIII-65; Maranhão 1♀ 12-VI-66.

362. *Phoebis (Phoebis) argante argante* (F., 1775).
SobrdW 1♂ 12-VIII-65, c 24-II-66; Contagem c 23-II-66; Fercal c 23, 25-II-66; Maranhão c 15-VIII-65; JZool c 21-II-66; BrasCC 2s 11-VI-66;

PGama 3s 9-VI-66; Vead 1♂; PPEflex c 7-VI-66; PPW 1♀s 19-II-66, c 27-II-66, c 7-VI-66.

363. *Phoebis (Phoebis) philea philea* (Joh., 1767).
SobrdW c 24-II-66; Contagem 2s 23-II-66; Fercal c 23, 25-II-66; Maranhão c 15-VIII-65; JZool c 21-II-66, c 8-VI-66; PGama 2s 9-VI-66; Anap 1♀ XII-35, 1♂ XII-36; K485 c 22-VIII-65, c 26-II-66; PPW c 19, 27-II-66.

364. *Phoebis (Phoebis) sennae sennae* (L., 1758).
SobrdW c 24-II-66, c 10-VI-66; Fercal 1♂ 17-VIII-65, c 23, 25-II-66; Maranhão 1♂ 18-VIII-65, c 12-VI-66; JZool 1♂ 1-II-62, 3♀ 25-XII-63, c 21-II-66, c 8-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 1♂ 1♀; Anap 1♀ XI-35, 1♀ XII-35, 1♂ 1♀ 2-III-36; K485 1♂ 22-VIII-65, c 26-II-66; K222 1♂ 20-II-66; PPEflex c 7-VI-66; PPW c 27-II-66, c 6, 7-VI-66.

365. *Anteos menippe* (Hbn., 1819).
SobrdW 1♂ 11-VIII-65; Contagem 2s 23-II-66; Fercal c 23, 25-II-66; JZool 1♂ 1-II-62, 2♂ 25-XII-63, 1♂ 1-II-64, c 21-II-66; PGama 1s 9-VI-66; Vead 1♂; Goiânia 1♂ 1962; Go 1♂. Most common around leguminous trees in towns, also in open country.

366. *Anteos clorinde* (Godt., 1823).
JZool 1s 8-VI-66; K222 1s 8-VIII-65. Migratory, fluctuates widely from year to year; probably common in the planalto in favorable seasons.

367. *Leucidia elvina* (Godt., 1819).*
Parac 1♂ 10-V-19, 2♂ 27-III-20, 3♂ 10-VIII-20.

Pierinae

368. *Ascia monuste monuste* (L., 1764).
Fercal c 23-II-66; JZool 1♂ 20-II-63, c 21-II-66; Cav 1♂; Anap 1♀ II-36; PPEflex 2s 19-II-66, 1♀ 7-VI-66.

369. *Appias drusilla drusilla* (Cr., 1777).
SobrdW 1♂ 12-VIII-65, 4s 10-VI-66; Maranhão 1♂ 14-VIII-65, 1♂ 15-VIII-65, c 12-VI-66; BrasCC c 11-VI-66; PGama c 9-VI-66; Vead 2♂.

370. *Hesperocharis (Hesperocharis) anguitea* (Godt., 1819).*
Fercal 1s 23-II-66, 2♂ 25-II-66; Vead 1♂; PPW 1s 7-VI-66.

371. *Hesperocharis (Cunizza) hirlanda phanasia* Fruhst., 1910.
PGama 2♂ 9-VI-66; Tag 1♂ (PG); K485 1♂ 26-II-66; PPW 1s 6-VI-66; Go 1♂ (PG). Local; very similar to the following species in habits and appearance. Most easily captured on damp sand in early afternoon.

372. *Melete lycimnia paulista* Fruhst., 1907.*
SobrdR 1♂ 11-VIII-65, 1♂ 12-VIII-65; SobrdW 2s 22-II-66, c 24-II-66; Fercal c 23, 25-II-66; Maranhão 1♂ 14-VIII-65, 3s 12-VI-66; JZool c 21-II-66, 1s 8-VI-66; BrasCC 1♀ 11-VI-66; PGama 1♂s 9-VI-66; Vead 5♂; Tag 1♂; Camp 1♂ III-30; K485 c 22-VIII-65; PPW c 19-II-66, c 6, 7-VI-66.

273. *Archonias tereas tereas* (Godt., 1819).*
SobrdR 1♂ 22-II-66; SobrdW 1s 11-VIII-65, 2s 12-VIII-65, 1♂ 22-II-66, c 24-II-66, c 10-VI-66; JZool 1♂ 21-II-66; BrasCC 2s 11-VI-66; PGama 1♂ 9-VI-66; PPW 1s 6-VI-66. Deep woods near water; evidently mimics *Parides*.

Dismorphiinae

374. *Dismorphia psamathe* (F., 1793).
SobrdW 1♂ 11-VIII-65, 1♀ 12-VIII-65, 1♂ 22-II-66; Fercal 1♂ 23-II-66, 2♂ 25-II-66; JZool 1♀ 31-I-62, 1♀ 21-II-66; PGama 1♀ 9-VI-66; Vead 1♂.

375. *Dismorphia thermesia thermesia* (Godt., 1819).*
SobrdW 1♂ 12-VIII-65, 1♂ 22-II-66, 1♀ 24-II-66, 1♂ 10-VI-66; BrasCC c 11-VI-66. Occurs in local colonies in deep woods.

376. *Dismorphia limnorina* Feld., 1865.*
Arag 1♂ X-31.

377. *Dismorphia astyocha* (Hbn., 1824).*
PPW 2♀ 27-II-66. Probably barely reaches the planalto, from the south. Mimics *Mechanitis.*
378. *Dismorphia astynome astynome* (Dalm., 1823).*
SobrdW 1♀ 13-VIII-65, c 22, 24-II-66, 1♂ 10-VI-66; Contagem 1♀ 23-II-66; Maranhão 1♂ 2♀ 12-VI-66; JZool 1♀ 21-II-66; PGama 1♂ 9-VI-66; Anap 1♂ VIII-36; PPW 1♀ 19-II-66. Not distinguishable from *Mechanitis* in flight.
379. *Pseudopieris nehemia nehemia* Bdv., 1836.
SobrdW 2♂ 22-II-66, 3s 24-II-66; Contagem 1♂ 17-VIII-65, 2s 23-II-66; Fercal 1♂ 23-II-66; Anap 1♂ XI-36, 1♂ XII-36. Deep woods.

We expect the list of Pieridae to grow by at least three or four species, possibly including *Ascia buniae, Dismorphia melite* and *Phoebis trite.*

Total for Pieridae: 31 species. Predicted to occur on planalto: approximately 35 species, therefore about 88% of the total represented on present list.

Papilionidae

Determinations were made by Dr. Romualdo Ferreira d'Almeida. Order and nomenclature follow his recent catalogue (d'Almeida, 1966).

380. *Battus (Parides) anchises orbignyanus* (Lucas, 1852).
SobrdR 1♀ 22-II-66; SobrdW c 22, 24-II-66; Contagem 1♂ 1♀ 23-II-66; Maranhão 1♂ 14-VIII-65; Vead 3♂ 2♀; Tag 2♂ 2♀; Anap 1♂ 7-XII-36, 1♂ II-37; Leop 1♂ XII-37; Vian 2♀ III-30; K485 1♀ 22-VIII-65, 1♂ 26-II-66; PPEflex c 19, 27-II-66; PPW 2♂ 2♀ 19-II-66, c 27-II-66; Go 3♂. Usually found in deep woods near water.
381. *Battus (Parides) burchellanus* (Westw., 1872).
Maranhão c 14, 15, 18-VIII-65, 1♂ 23-II-66; Anap 1♀ III-37; Go 2♂. Very local; flies low and in a deliberate appearing manner, rarely more than 1 m from banks of large, forested rivers.
382. *Battus (Parides) diodorus* (Hopff., 1866).
Tag 1♂ 1♀; PPEflex 1♂ 19-II-66; Km. 397 Belo Horizonte-Brasília (Município João Pinheiro) 1♂s 20-II-66. Local; found more in open cerrado than other *Parides.*
383. *Battus (Parides) neophilus eurybates* (Gray, 1852).
Tag 2♂ 2♀; Anap 1♂ 8-I-35, 1♀ IX-36, 1♂ II-37, 1♀ III-37, 1♂ 1♀ VI-37; Camp 1♂ I-38; Vian 1♂ III-30; K485 1♂ 26-II-66; PPEflex c 19, 27-II-66; PPW 1♂ 2♀ 27-II-66, 2♀ 6-VI-66, 1♂ 1♀ 7-VI-66. Flies close to the ground in deep woods; visits flowers, especially in early morning.
384. *Battus (Parides) nephalion* (Godt., 1819).*
Maranhão 1♀ 12-VI-66; JZool 1♂ 20-II-63, 1♀ 21-II-66; Camp 1♂ I-38; Leop 2♀ XII-37.
385. *Battus (Parides) panthonus jaguarae* (Foett., 1902).
Fazenda Jaguará, Rio das Velhas, Minas Gerais 2♂ II-1898 (MN). This locality may be slightly outside map area, in the "blend zone."
386. *Battus (Parides) proneus* (Hbn., 1825).*
Anap 1♂ 27-VII-37.
387. *Battus (Parides) tros* (F., 1793).*
Go 1♀ XI-31 (DZ).
388. *Battus (Battus) crassus* (Cr., 1777).
Fercal 2♂s 25-II-66; JZool 1♂ 1-II-62; Vead 1♂.
389. *Battus (Battus) polydamas polydamas* (L., 1758).
SobrdR 1♂s 22-II-66; Fercal 1♂ 23-II-66, 1♂ 25-II-66; JZool 1♀ 21-II-66,

1♂ 1♀s 8-VI-66; PPW 1s 19-II-66, 1s 27-II-66. Open and cultivated areas.

390. *Papilio anchisiades capys* (Hbn., 1809).*
Fercal 1s 25-II-66; Vead 2♂; Anap 3♂ XII-35, 1♂ 24-VI-36, 1♂ XII-36; Km. 425 Belo Horizonte-Brasília (Município João Pinheiro) 1♂ 26-II-66. Sporadically common.

391. *Papilio himeros baia* Roths. & Jord., 1906.
Tag 1♂.

392. *Papilio scamander grayi* Bdv., 1836.*
JZool 1♀ 27-I-62.

393. *Papilio thoas brasiliensis* Roths. & Jord., 1906.
SobrdR 1s 22-II-66; SobrdW 1s 13-VIII-65, 1♂ 22-II-66, 1s 24-II-66; Maranhão 1s 23-II-66; JZool 1s 21-II-66; Vead 2♂; PPW 1s 19-II-66.

394. *Papilio torquatus polybius* Swainson, 1823.*
Vead 1♀; PPW c 19, 27-II-66. Wooded areas.

395. *Graphium autosilaus viridis* (Röber, 1926).
RClaro 1♂ 15-VIII-63.

396. *Graphium earis* (Roths. & Jord., 1906).
Vead 3♂; Go 1♂ 1926.

397. *Graphium helios* (Roths. & Jord., 1906).
Vead 1♂; Go 1♂ 1926.

398. *Graphium lysithous* (Hbn., 1821).*
Anap 1♂ 27-VII-37.

399. *Graphium protesilaus protesilaus* (L., 1758).
Anap 1♂ X-37.

We expect this list to reach at least 28, with additional species of *Graphium* (e.g. *dolicaon, telesilaus, orthosilaus, ariarathes*, all known from Mato Grosso), and some *Papilio* (*astyalus* and *androgeus*).

Total for Papilionidae: 20 species. Predicted to occur on planalto: approximately 28 species, therefore about 70% of the total represented on the present list.

Hesperiidae

Identifications by O.M. The arrangement and nomenclature follow Evans (1951–1955).

Pyrrhopyginae

400. *Pyrrhopyge pelota* Plötz, 1879.
Leop 6♂ 1♀ XI-37; Arag 1♂ 2♀ II-30.

401. *Elbella losca* Evans, 1951.
Fercal 1♂ 25-II-66; PPW 1♂ 27-II-66. Visits wet sand, flowers.

402. *Jemadia menechmus* (Mab., 1878).
Vead 1♂.

403. *Jemadia hewitsoni brevipennis* Schaus, 1902.
Vead 1♀.

404. *Mimoniades versicolor versicolor* (Latr., 1823).*
JZool 1♀ 21-II-66, 1♀ 8-VI-66 (KB). On *Eupatorium* flower.

405. *Hegesippe luteizona* (Mab., 1877).*
Goiânia 1♂ 6-III-63. Represents the form *josepha* Plötz.

406. *Mysoria thasus thasus* (Stoll, 1781).
K485 3♂ 26-II-66 (1 with KB). At wet sand by river.

407. *Mysoria barcastus barta* Evans, 1951.
Fercal 1♂ 1♀ 23-II-66, 1♂ 25-II-66 (males with KB); JZool 1♂ 8-VI-66 (KB); PGama 1♂ 9-VI-66 (KB); Vead 2♂; Anap 1♀ 19-II-37; Vian 1♀ XI-31; Parac 1♀ 27-III-20. Males on wet sand, females on flowers.
408. *Microceris variicolor* (Mén., 1855).
BrasCC 1♂ 11-VI-66 (KB); Vead 2♂; Cav 1♂; Camp 1♂ 16-XII-35 (OC); Anap 1♂ 10-XI-50 (OM); Arag 1♂ II-30; Go 1♂. Males on wet sand.
409. *Myscelus amystis epigona* H.-Sch., 1869.*
PPW 1♂ 27-II-66.
410. *Myscelus epimachia epimachia* H.-Sch., 1869.
Vead 1♂; Leop 1♂ XI-37.

We expect this list to grow by at least nine species, probably including the following, which are already known from the interior of Brazil: *Elbella intersecta ilona*, *Jemadia fallax*, and *Passova passova practa*, as well as three species of *Pyrrhopyge* and another each of *Jemadia* and *Elbella*.

Pyrginae (Section A)

411. *Phocides polybius phanias* (Burm., 1880).
SobrdW 1♀ 22-II-66; JZool 1♀ 29-I-61; Vead 1♂.
412. *Phocides metrodorus metrodorus* Bell, 1932.
Vead 3♂.
413. *Phocides pigmalion hewitsonius* (Mab., 1883).
Vead 1♂.
414. *Phanus australis* Miller, 1965.*
SobrdW 1♀ 22-II-66, 2♀ 24-II-66; Cav 1♂; Vian 1♂ XI-31.
415. *Phanus vitreus* (Stoll, 1781).
SobrdW 1♂ 24-II-66 (KB); Cav 1♂. Latter specimen has genitalia identical to those figured by Miller (1965) for the "unclassified specimen no. 1," fig. 10♂, 16 valva. Miller's specimen probably is an aberrant *P. vitreus.*
416. *Udranomia orcinus* (Feld., 1867).
SobrdW 1♂ 24-II-66; Vian 1♂ III-30. Alights with wings held in an open position, as does *U. spitzi.*
417. *Udranomia spitzi* (Hayw., 1942).
SobrdR 1♂ 22-II-66; BrasCC 1♀ 11-VI-66 (KB); Camp 1♀ I-38; Leop 1♂ X-37, 1♀ XI-37; Arag 1♀ XII-31.
418. *Drephalys dumeril* (Latr., 1824).
K222 1♂ 20-II-66. Flies within the forest and lands with wings semiclosed, under leaves.
419. *Augiades epimethea epimethea* (Plötz, 1883).
SobrdW 1♀ 22-II-66; PPW 1♂ 1♀ 19-II-66, 3♂ 27-II-66. Flies within the forest, lands with wings open, under leaves.
420. *Proteides mercurius mercurius* (F., 1781).
Fercal 1♂ 17-VIII-65 (KB); Cav 2♂. Lands with wings closed; visits wet sand.
421. *Epargyreus enispe* (Hew., 1867).*
Camp 1♀ XII-35 (OM); Leop 3♀ X-37, 1♀ XI-37, 1♀ XII-37; Arag 1♀ XII-31.
422. *Epargyreus socus socus* Hbn., 1825.
Maranhão 1♂ 17-VIII-65 (KB); Leop 1♂ XI-37; PPW 2♂ 19-II-66, 1♂ 27-II-66.
423. *Epargyreus exadeus exadeus* (Cr., 1779).
Fercal 1♂ 25-II-66; Vead 2♂; Cav 1♂; Vian 1♀ III-30.

424. *Epargyreus clavicornis clavicornis* (H.-Sch., 1869).
SobrdW 1♂ 24-II-66. All the species of *Epargyreus* land with wings closed.
425. *Polygonus leo leo* (Gmelin, 1790).
Cav 1♀; Arag 1♂ X-31; PPW 1♂ 2♀ 19-II-66, c 27-II-66.
426. *Polygonus manueli manueli* Bell & Comstock, 1948.
Parac 1♂ 22-XII-20, 1♂ 20-II-22. The species of *Polygonus* fly within the forest, land under leaves with wings closed; on flowers land with wings open.
427. *Chioides catillus catillus* (Cr., 1779).
SobrdW 1♂ 11-VIII-65 (KB), 1♂ 22-II-66; Fercal 1♂ 15-VIII-65, 3♂ 17-VIII-65, 1♂ 23-II-66; Vead 3♂; Leop 5♂ 1♀ XI-37; Vian 1♂ III-30; PPW 1♀ 27-II-66. Lands with wings closed; visits wet sand.
428. *Aguna asander asander* (Hew., 1867).
SobrdW 1♀ 22-II-66; Maranhão 1♂ 17-VIII-65; Camp 1♂ 1♀ I-38; K222 c 20-II-66; PPW c 19, 27-II-66, 1♀ 6-VI-66. Flies within the forest and lands under leaves with wings closed; also common on flowers.
429. *Aguna hypozonius* (Plötz, 1881).
SobrdW 1♂ 22-II-66. Alights with wings closed, as do the following two species.
430. *Aguna albistria albistria* (Plötz, 1881).
SobrdW 1♀ 12-VIII-65 (KB), 1♂ 22-II-66; JZool 1♂ 22-II-63, 1♀ 20-II-66; Goiânia 1♂ 6-III-63; Leop 1♂ X-37, 1♂ XI-37; Vian 1♀ III-30.
431. *Typhedanus undulatus* (Hew., 1867).
JZool 1♀ 21-II-66, 1♂ 8-VI-66; K485 1♂ 26-II-66; K222 1♂ 1♀ 20-II-66.
432. *Polythrix octomaculata octomaculata* (Sepp, 1848).
Maranhão 1♂ 18-VIII-65 (KB). Perches with wings open.
433. *Codatractus aminias* (Hew., 1867).
Fercal 1♂ 17-VIII-65 (KB). Alights with wings closed.
434. *Urbanus proteus proteus* (L., 1758).
SobrdW 1♀ 12-VIII-65; Fercal 2♂ 25-II-66; JZool 2♂ 2♀ 21-II-66, 1♂ 8-VI-66; Camp 1♂ I-38; Goiânia 1♀ 7-III-63; PPW 1♂ 19-II-66.
435. *Urbanus esmeraldus* (Butl., 1877).
Vead 1♂; K222 1♂ 20-II-66 (KB).
436. *Urbanus esma* Evans, 1952.
PPW 1♂ 19-II-66.
437. *Urbanus esta* Evans, 1952.
SobrdW 1♂ 12-VIII-65, 1♂ 1♀ 13-VIII-65; Fercal 1♀ 25-II-66; JZool 2♀ 21-II-66; Goiânia 1♂ 30-I-62; Leop 1♂ XI-37.
438. *Urbanus dorantes dorantes* (Stoll, 1790).
SobrdW 1♀ 22-II-66; JZool 3♂ 21-II-66; Vead 1♂; Cav 1♀; Camp 1♂ I-38; Leop 3♂ 1♀ XI-37; PPEflex 1♂ 19-II-66; PPW 1♀ 19-II-66. Widely distributed and common, more so than the records indicate.
439. *Urbanus teleus* (Hbn., 1821).
SobrdW 2♂ 11-VIII-65, 1♂ 13-VIII-65; Fercal 1♂ 23-II-66, 1♂ 25-II-66; JZool 2♀ 21-II-66; PPW 1♂ 19-II-66. Generally distributed and common.
440. *Urbanus simplicius* (Stoll, 1790).
SobrdW 1♂ 22-II-66; Contagem 2♂ 23-II-66; Fercal 1♂ 25-II-66; Goiânia 1♂ 6-III-63; K485 1♂ 26-II-66; K222 2♂ 20-II-66; PPEflex 1♂ 19-II-66.
441. *Urbanus procne* (Plötz, 1881).
JZool 1♂ 21-II-66, 1s 8-VI-66.
442. *Urbanus cindra* Evans, 1952.
Fercal 1♂ 25-II-66; Leop 10♂, 1♀ XI-37.
443. *Urbanus evenus* (Mén., 1855).
SobrdW 1♂ 24-II-66; JZool 1s 21-II-66; Camp 1♀ I-38; Leop 1♂ X-37, 2♂ 3♀ XI-37; Vian 1♂ 1♀ III-30, 1♀ XII-31; K222 2♂ 20-II-66; Pirapora, Minas Gerais 1♂ 1♀ (DZ). Flies only in the cerrado.

444. *Urbanus doryssus doryssus* (Swains., 1831).
SobrdW 1♂ 22-II-66 (KB).
445. *Urbanus doryssus albicuspis* (H.-Sch., 1869).
Camp 1♀ I-38. The planalto may be the meeting point of these rather distinct appearing subspecies.
446. *Urbanus albimargo takuta* Evans, 1952.
Maranhão 1♂ 15-VIII-65 (KB).
447. *Urbanus virescens* (Mab., 1877).
Contagem 2♂ 23-II-66 (1 with KB). With the exception of *U. dorantes* which lands with closed wings, members of *Urbanus* generally land with semi-open wings.
448. *Astraptes fulgerator fulgerator* (Walch, 1775).
SobrdW 1♂ 24-II-66; Camp 1♀ I-38; Vian 1♀ XI-31; PPW 1♂ 27-II-66, 1♂ 6-VI-66.
449. *Astraptes alardus alardus* (Stoll, 1790).
SobrdW 2♂ 12-VIII-65 (KB).
450. *Astraptes creteus siges* (Mab., 1903).*
Camp 1♂ I-38; PPW 1♂ 27-II-66. The species of *Astraptes* land with wings usually semi-open but at times closed.
451. *Autochton zarex* (Hbn., 1818).
Fercal 1♂ 23-II-66; Vead 1♂; Camp 1♂ 20-XII-35 (OC); Vian 1♂ 1 undetermined sex III-30.
452. *Autochton neis* (Geyer, 1832).
Fercal 1♀ 25-II-66; Maranhão 1♂ 12-VI-66 (KB); JZool 2♂ 1♀ 21-II-66.
453. *Autochton integrifascia* (Mab., 1891).
PPEflex 1♂ 7-VI-66 (KB).
454. *Autochton itylus* Hbn., 1823.
JZool 2♂ 21-II-66 (1 with KB). The species of *Autochton* land with wings semi-open.
455. *Bungalotis erythus* (Cr., 1775).
PGama 1♂s 9-VI-66. Seen at close range with binoculars to verify identification. This individual landed with wings open, under a rock on a vertical cliff face in the shade.
456. *Sarmientoia phaselis* (Hew., 1867).
Vead 1♂; Tag 1♂.
457. *Cephise cephise hydarnes* (Mab., 1876).
PPEflex 1♂ 7-VI-66 (KB). Lands with wings semi-open, under leaves.
458. *Celaenorrhinus similis similis* Hayw., 1933.
SobrdW 1♀ 22-II-66; Fercal 1♂ 17-VIII-66; Maranhão 2♀ 14-VIII-65; Camp 1♂ 1-I-36 (OC), 3 undetermined sex I-38; PPW 2♂ 27-II-66, 1♀ 6-VI-66. Lands under leaves with wings open.

We expect Section A of the Pyrginae to be represented by about 80 species in the planalto (there are 47 on this list), including a number of crepuscular and nocturnal forms which are very poorly known. At least the following species are recorded by Evans from Goiás, from specimens in the British Museum: *Phocides thermus valgus, Entheus eumelus ninyas, Typhedanus orion, T. optica goya, Polythrix roma, P. caunus,* and *Astraptes colossus rhoda.*

PYRGINAE (Section B)

459. *Spathilepia clonius* (Cr., 1775).
Fercal 1♂ 23-II-66 (KB). Lands with wings semi-open.

460. *Cogia abdul* Hayw., 1946.
SobrdW 1♀ 22-II-66; Leop 3♂ XII-37; Vian 1♂ 1♀ III-30; Arag 1♂ III-30.
461. *Cogia calchas* (H.-Sch., 1869).
Vead 1♂; RClaro 1♀ 18-VIII-63; Leop 1♂ III-38; Vian 1♂ 1♀ XII-29, 2♀ III-30; Arag 1♂ III-30; K485 3♂ 26-II-66.
462. *Cogia grandis* Riley, 1921.
Camp 1♂ 1♀ XII-35 (OM); Leop 1♀ II-30, 3♀ X-37, 3♀ XI-37, 1♀ XII-37; Vian 1♀ III-30; Arag 1♀ II-30.
463. *Telemiades amphion marpesus* (Hew., 1876).*
SobrdW 1♂ 24-II-66 (KB).
464. *Telemiades laogonus nicola* (Plötz, 1882).
Vian 1♀ III-30.
465. *Spioniades artemides* (Stoll, 1782).
SobrdR 1♂ 22-II-66 (KB); Maranhão 1♂ 18-VIII-65 (KB).
466. *Sophista latifasciata latifasciata* (Spitz, 1930).
Vian 1♀ III-30; Leop 1♀ X-37, 1♂ XI-37; Arag 1♂ II-30, 1♀ III-30.
467. *Polyctor polyctor polyctor* (Prittw., 1868).
Maranhão 1♂ 18-VIII-65 (KB); PPW 1♂ 27-II-66.
468. *Nisoniades macarius* (H.-Sch., 1870).
Fercal 1♂ 23-II-66; JZool 1♂ 21-II-66.
469. *Nisoniades bipuncta* (Schaus, 1902).*
Fercal 1♂ 25-II-66; Camp 1♂ I-38.
470. *Nisoniades castolus* (Hew., 1878).
SobrdW 1♂ 24-II-66; Fercal 1♂ 25-II-66; Vian 1♂ III-30; K222 1♂ 20-II-66.
471. *Pachyneuria inops* (Mab., 1877).*
SobrdW 4♂ 24-II-66.
472. *Pellicia costimacula costimacula* (H.-Sch., 1870).
Camp 1♂ III-30; K485 1♂ 26-II-66.
473. *Pellicia dimidiata zamia* (Mab., 1878).
Fercal 1♂ 23-II-66; Maranhão 1♂ 12-VI-66 (KB).
474. *Pellicia ranta rancida* Evans, 1953.*
Camp 1♂ III-30.
475. *Pellicia chapada* Will. & Bell, 1939.
Vead 1♂ (OM).
476. *Morvina fissimacula fissimacula* (Mab., 1878).*
PPW 4♂ 1♀ 27-II-66 (3♂ with KB).
477. *Viola violella* (Mab., 1897).
SobrdR 1♂ 22-II-66; SobrdW 2♂ 22-II-66; Fercal 4♂ 25-II-66; JZool 1♂ 21-II-66; RClaro 1♂ 13-III-63; Leop 1♂ X-37, 1♂ XI-37; Vian 1♀ III-30, 1♂ XII-31; K222 1♂ 20-II-66.
478. *Staphylus epicaste melangon* (Mab., 1883).
Fercal 1♀ 25-II-66; Vead 1♂; Camp 1♂ I-38; Leop 1♂ XII-30; K222 1♂ 20-II-66; PPW 1♂ 27-II-66.
479. *Staphylus minor minor* Schaus, 1902.
Camp 1 indetermined sex I-38.
480. *Trina geometrina geometrina* (Feld., 1867).
Fercal 1♂ 23-II-66, 1♂ 25-II-66; Maranhão 1♂ 12-VI-66; JZool 1♂ 21-II-66; Anap 1♂; Camp 1♂ III-30, 1♂ I-38; Vian 2♂ III-30; PPW 1♂ 6-VI-66.
481. *Diaeus lacaena variegata* (Plötz, 1884).
Vian 1♂ III-38.
482. *Gorgythion begga begga* (Prittw., 1886).
SobrdW 1♂ 1♀ 22-II-66, 1♀ 24-II-66; Contagem 1♀ 23-II-66; Fercal 2♂ 25-II-66; JZool c 21-II-66; Goiânia 1♂ 5-II-63; Leop 2♂ 2♀ XI-37; Vian 5♂ 2♀ III-30; K485 1♂ 26-II-66; K222 1♂ 1♀ 20-II-66; PPEflex 6♂ 19-II-66; PPW 1♂ 6-VI-66. Widely distributed and generally common in wooded areas.

483. *Gorgythion beggina escalophoides* Hayw., 1941.
SobrdW 2♂ 22-II-66; Leop 1♂ X-37; Vian 4♂ 4♀ III-30, 1♂ XI-31; Arag 2♂ II-30; K485 1♂ 26-II-66.
484. *Gorgythion canda* Evans, 1953.
SobrdW 2♂ 22-II-66; Vian 2♂ III-30; Arag 2♂ II-30; K485 c 26-II-66; K222 1♂ 20-II-66.
485. *Quadrus ceriales* (Stoll, 1782).
JZool 1♀ 8-VI-66; PPEflex 1♂ 2♀ 27-II-66.
486. *Gindanes brebisson brebisson* (Latr., 1824).*
SobrdW 1♂ 1♀ 24-II-66.
487. *Pythonides jovianus fabricii* Kirby, 1871.
Vead 1♀; Camp 1♂ I-38; Leop 1♀ III-38; Vian 1♀ III-30; K485 3♂ 26-II-66; K222 c 20-II-66; PPW 1♂ 27-II-66.
488. *Pythonides lancea* (Hew., 1868).*
K485 1♂ 26-II-66; K222 1♂ 20-II-66; PPW 1♂ 27-II-66.
489. *Pythonides tullia* Evans, 1953.*
Cav 1♂.
490. *Pythonides herennius herennius* Geyer, 1838.
Vead 1♂.
491. *Pythonides grandis assecla* Mab., 1883.
Camp 1♀ I-38; Vian 1♂ III-30, 1♀ XI-31.
492. *Pythonides limaea limaea* (Hew., 1868).
K222 1♂ 20-II-66.
493. *Sostrata cronion* (Feld., 1867).
Parac 1♀ 20-II-19.
494. *Milanion hemes memba* Evans, 1953.
Leop 1♂ XII-37; Vian 1♂ III-30.
495. *Mylon menippus* (F., 1776).
SobrdW 2♂ 24-II-66; Fercal 1♂ 25-II-66; Camp 1♂ I-38.
496. *Mylon pelopidas* (F., 1793).
JZool 1♂ 21-II-66, 2♂ 8-VI-66 (KB).
497. *Xenophanes tryxus* (Stoll, 1780).
Fercal 2♂ 23-II-66; JZool 1♀ 20-II-63, 3♂ 3♀ 21-II-66; Vead 1♂; Camp 1♂ III-30, 3♂ I-38; Vian 1♀ III-30; K222 1♂ 20-II-66; PPEflex 1♂ 2♀ 19-II-66; Fazenda Saia Velha, S. Distr. Fed. 1♂ 1-III-63 (NT).
498. *Antigonus nearchus* (Latr., 1824).
Fercal 1♂ 23-II-66, 1♂ 25-II-66; Maranhão 1♂ 18-VIII-65; Vead 1♂; Leop 2♂ XII-37.
499. *Antigonus erosus* (Hbn., 1812).
Contagem 1♀ 23-II-66; Fercal 2♂ 23-II-66, 1♂ 25-II-66; JZool 1♀ 21-II-66; Vead 3♂; Camp 1♂ I-38; Leop 3♂ XII-37; K222 1♂ 20-II-66; PPW 2♀ 19-II-66.
500. *Antigonus liborius liborius* Plötz, 1884.*
JZool 1♂ 21-II-66.
501. *Timochreon satyrus tampa* Evans, 1953. (?)
RClaro 1♂ 21-VIII-63. Subspecies incertain.
502. *Zopyrion evenor evenor* Godm. & Salv., 1901.
Arag 1♂ II-30; K222 c 20-II-66; PPEflex 1♂ 19-II-66.
503. *Zopyrion reticulata* Hayw., 1942.
Leop 1♂ 1♀ XI-37, 4♂ 1♀ III-38; Vian 1♀ (allotype) III-30.
504. *Anisochoria pedaliodina extincta* Hayw., 1933.
Fercal 1♂ 25-II-66; PPW 1♀ 19-II-66.
505. *Anisochoria superior* Mab., 1897.
Leop 1♂ XII-37.

506. *Anisochoria vianna* Evans, 1953.
Leop 2♂ XII-37; K485 2♂ 26-II-66.
507. *Achlyodes busirus rioja* Evans, 1953.
Contagem 1♂ 1♀ 23-II-66; Maranhão 1♀ 14-VIII-65, 1♀ 15-VIII-65; Vead 2♂; Vian 1♀ III-30; K485 1♀ 26-II-66; K222 2♀ 20-II-66; PPW 1♂ 27-II-66.
508. *Achlyodes thraso thraso* (Hbn., 1807).
SobrdW 1♂ 22-II-66, 2♂ 24-II-66; Contagem 1♂ 1♀ 23-II-66; Maranhão 1♀ 14-VIII-65; JZool 1♂ 2♀ 21-II-66; Vian 3♂ 2♀ III-30; PPW 2♀ 27-II-66.
509. *Grais stigmaticus stigmaticus* (Mab., 1883).
SobrdR 1♂ 11-VIII-65; SobrdW 2♂ 1♀ 22-II-66; JZool 1♂ 21-II-66.
510. *Timochares trifasciata trifasciata* (Hew., 1868).
SobrdW 1♂ 11-VIII-65, 1♂ 12-VIII-65; Fercal 1♂ 23-II-66.
511. *Anastrus sempiternus simplicior* (Moeschler, 1876).
SobrdW 1♂ 24-II-66; PGama 1♂ 9-VI-66; Leop 1♂ XII-37; K485 1♂ 26-II-66.
512. *Ebrietas anacreon anacreon* (Stgr., 1876).
SobrdW 1♀ 24-II-66; Contagem 1♂ 23-II-66; Fercal 4♂ 23-II-66; Camp 1♂ I-38; Leop 2♂ XII-37.
513. *Cycloglypha polax* Evans, 1953.
Vead 1♂ (OM); Arag 1♂ II-30.
514. *Cycloglypha thrasibulus thrasibulus* (F., 1793).
SobrdW 1♂ 22-II-66; Vead 1♂; Camp 1♂ I-38; Leop 1♂ XII-37; K485 1♂ 26-II-66; K222 1♂ 2♀ 20-II-66.
515. *Helias phalaenoides palpalis* (Latr., 1824).
SobrdW 1♀ 13-VIII-65; Contagem 1♀ 23-II-66; Fercal 2♂ 25-II-66; Leop 1♂ XII-37; Vian 3♂ III-30; Parac 1♀ 4-III-21; PPEflex 2♂ 1♀ 19-II-66, 1♂ 27-II-66.
516. *Camptopleura auxo* (Moeschler, 1878).
Fercal 1♂ 25-II-66; K222 1♂ 20-II-66.
517. *Theagenes dichrous* (Mab., 1878).*
SobrdR 1♂ 22-II-66 (KB).
518. *Chiomara asychis autander* (Mab., 1891).
Maranhão 1♂ 15-VIII-65 (KB).
519. *Chiomara crenda* Evans, 1953.*
Leop 1♂ XII-37.
520. *Chiomara punctum* (Mab., 1878).
Fercal 1♂ 25-II-66; Maranhão 1♂ 23-II-66; JZool 1♂ 27-I-62; Leop 1♂ 1♀ II-30, 2♂ 1♀ XI-37; Vian 1♀ III-30; K485 1♂ 26-II-66.
521. *Gesta gesta gesta* (H.-Sch., 1863).
Fercal 3♂ 1♀ 25-II-66; JZool 1♂ 21-II-66; Goiânia 1♂ 30-I-62; Vian 1♂ 1♀ III-30; PPEflex 1♂ 19-II-66.
522. *Gesta heteropterus* (Plötz, 1884).
Anap 1♂ XII-35.
523. *Gesta austerus* (Schaus, 1902).
Leop 1♂ XII-37; K222 1♂ 20-II-66.
524. *Pyrgus oileus orcus* (Stoll, 1780).
Maranhão 1♀ 17-VIII-65; JZool 1♂ 21-II-66; Goiânia 1♂ 29-I-62, 1♂ 1♀ 30-I-62; Camp 1♂ (OC); RClaro 1♂ 12-VIII-63; Leop 1♀ III-38; PPEflex 2♂ 1♀ 19-II-66, 1♀ 7-VI-66; Ponte Funda, Goiás (Near Vian) 1♂ 1-III-63 (NT). A widespread, common subspecies.
525. *Heliopetes macaira orbigera* (Mab., 1888).
JZool 1♂ 21-II-66.

526. *Heliopetes domicella willi* (Plötz, 1884).
Arag 2♂ II-30; PPW 1♀ 19-II-66.
527. *Heliopetes omrina* (Butl., 1870).
JZool 1♂ 1♀ 21-II-66; Goiânia 1♂ 30-I-62; Leop 1♀ XII-37; Vian 1♀ III-30, 1♂ XI-31; K222 1♂ 20-II-66; PPW 1♀ 6-VI-66.
528. *Heliopetes arsalte arsalte* (L., 1758).
SobrdW 1♂ 12-VIII-65, 1♂ 13-VIII-65; Fercal 1♂ 23-II-66; Maranhão 1♂ 18-VIII-65; JZool 2♂ 1♀ 21-II-66; Camp 1♀ I-38; RClaro 1♂ 12-VIII-63, 1♂ 13-VIII-63; Leop 1♂ XI-37, 1♂ XII-37; Vian 1♂ 1♀ III-30; Arag 2♂ II-30; K222 2♂ 20-II-66; PPEflex 1♂ 1♀ 19-II-66, 1♀ 7-VI-66. Widespread and generally common.
529. *Heliopetes randa* Evans, 1953.
Parac 1♂ 22-XII-22.
530. *Heliopetes alana* (Reak., 1868).
Fercal 2♂ 25-II-66; JZool 1♂ 20-II-63, 3♂ 21-II-66; Camp 2♂ 1♀ I-38; Vian 3♂ 1♀ III-30; K222 1♂ 20-II-66.
531. *Heliopetes petrus* (Hbn., 1819).
Vead 1♂.

The present number of Pyrginae in Section B (72) will probably be increased to about 120 in the complete list. We expect the following species to be recorded from the planalto (those with a (‡) are recorded from Goiás by Evans, specimens in the British Museum): *Oechydrus chersis* subsp., *Marela tamyris* and *tamyroides, Cogia hassan evansi* (‡) and *punctilia* (‡), *Telemiades squanda* (‡), *nicomedes brazus, epicalus, penidas*, and *antiope, Pyrdalus corbulo, Eracon clinias, Mictris crispus, Sophista aristoteles, Nisoniades mimas, Pellicia vecina najoides* and *theon, Myrinia santa monka, Gorgopas trochilus, Viola minor, Bolla atahuallpai* and *phylo oiclus, Staphylus buena* and *mazans ascalaphus, Gindanes brontinus bronta, Sostrata bifasciata adamas* (‡), *Milanion leucaspis, Mylon ander* (‡), *Mylon jason, Clito bibulus* (‡), *Clito clito, Timochreon doria, Aethilla echina echina* (‡), *Anastrus tolimus robigus* and *obscurus narva, Chiomara mithrax, Pyrgus communis orcynoides*, and *Heliopetes laviana libra*.

HESPERIINAE

532. *Dalla diraspes* (Hew., 1877).
Pirapora, M. G. (near João Pinheiro) 1 undetermined sex (DZ).
533. *Synapte antistia equa* Evans, 1955.
Goiânia 1♂ 1♀ (in copula) 30-I-62.
534. *Levina levina* (Plötz, 1884).*
Vead 1♂.
535. *Zariaspes mys* (Hbn., 1808).
Contagem 1♂ 23-II-66; Fercal 1♂ 1♀ 25-II-66.
536. *Anthoptus epictetus* (F., 1793).
Fercal 2♂ 25-II-66; JZool 1♂ 1♀ 21-II-66; Goiânia 1♂ 5-III-63; K222 1♂ 20-II-66; PPEflex c 19, 27-II-66.
537. *Vinius tryhana istria* Evans, 1955.
PPW 1♂ 19-II-66.
538. *Callimormus radiola pusillus* Hayw., 1934.
Maranhão 1♂ 12-VI-66 (KB).

539. *Callimormus saturnus* (H.-Sch., 1869).
SobrdW 1♀ 22-II-66, 2♂ 24-II-66; Contagem 1♂ 23-II-66; JZool 3♂ 1♀ 21-II-66; Camp 1♂ I-38; Vian 1♂ III-39; K485 4♂ 1♀ 26-II-66; PPEflex 4♂ 19-II-66; Ponte Funda (near Vian), Goiás 1♂ 1-III-63 (NT).
540. *Callimormus juventus* Sc., 1872.
JZool c 21-II-66; Leop 1♂ XII-37; Vian 3♂ 3♀ III-30; PPEflex 1♂ 27-II-66.
541. *Mnasicles hicetaon* Godm., 1901.
K222 1♂ 20-II-66; PPEflex 1♂ 19-II-66, 1♀ 27-II-66.
542. *Methionopsis ina* (Plötz, 1882).
JZool 5♂ 21-II-66.
543. *Sodalia sodalis* (Butl., 1877).
PPEflex 1♂ 19-II-66, 1♀ 27-II-66.
544. *Artines satyr* Evans, 1955.
Leop 1♂ XII-37.
545. *Aecas aecas* (Stoll, 1781).
SobrdW 1♂ 22-II-66 (KB).
546. *Lucida lucia lucia* (Capr., 1874).*
JZool 1♂ 21-II-66, 1♀ 22-II-66.
547. *Phanes aletes* (Geyer, 1832).
PPEflex 1♀ 19-II-66.
548. *Vidius vidius* (Mab., 1891).*
JZool 1♂ 21-II-66.
549. *Nastra lurida* (H.-Sch., 1869).*
Leop 1♀ XII-37.
550. *Nastra insignis* (Plötz, 1882).
Fercal 1♂ 23-II-66, 1♂ 25-II-66; JZool 1♀ 21-II-66.
551. *Cymaenes gisca* Evans, 1955.
SobrdW 1♀ 22-II-66; Fercal 1♂ 25-II-66; JZool 1♂ 1♀ 27-I-62, c 21, 22-II-66; Goiânia 1♂ 30-I-62; Vian 1♀ III-30; PPEflex c 19, 27-II-66, 1♀ 7-VI-66.
552. *Cymaenes tripunctus theogenis* (Capr., 1874).
Fercal 1♀ 25-II-66; JZool 1♂ 21-II-66; PPEflex 1♂ 19-II-66, 1♂ 27-II-66.
553. *Cymaenes chela* Evans, 1955.
SobrdW 1♂ 24-II-66; JZool 1♀ 21-II-66.
554. *Cymaenes laureolus loxa* Evans, 1955.
Maranhão 1♂ 23-II-66.
555. *Vehilius stictomenes stictomenes* (Butl., 1877).
Contagem 1♂ 23-II-66; Fercal 1♂ 1♀ 25-II-66; JZool 2♂ 3♀ 21-II-66; K222 3♂ 20-II-66; PPEflex c 19, 27-II-66; PPW 1♂ 6-VI-66.
556. *Vehilius inca* (Sc., 1872).
SobrdW 1♂ 22-II-66; Fercal 1♂ 25-II-66; JZool 2♂ 1♀ 21-II-66; K222 2♂ 1♀ 20-II-66; PPEflex 1♂ 19-II-66.
557. *Mnasilus allubita* (Butl., 1877).
Goiânia 1♂ 29-I-62; PPEflex c 19, 27-II-66.
558. *Moeris remus* (F., 1798).
SobrdW 1♀ 22-II-66, 2♂ 24-II-66; JZool 2♂ 21-II-66; BrasCC 1♂ 11-VI-66; Camp 1♂ I-38; Vian 1♂ 1♀ III-30.
559. *Papias subcostulata subcostulata* (H.-Sch., 1870).
SobrdW 1♂ 24-II-66; JZool 1♂ 2♀ 21-II-66, 1♂ 8-VI-66; PGama 1♂ 9-VI-66.
560. *Papias phainis* Godm., 1900.
Goiânia 1♂ 1♀ 30-I-62, 1♂ 5-III-63.
561. *Cobalopsis potaro* (Will. & Bell, 1931).
SobrdW 2♂ 22-II-66; Contagem 2♂ 1♀ 23-II-66; JZool c 21-II-66; PPW 1♂ 27-II-66.

562. *Cobalopsis nero* (H.-Sch., 1869).
SobrdW 1♀ 24-II-66.
563. *Lerema lineosa* (H.-Sch., 1865).
Leop 1♂ III-38.
564. *Morys geisa geisa* (Moeschler, 1878).
JZool 1♂ 21-II-66; K222 1♂ 1♀ 20-II-66; PPEflex 1♂ 1♀ 27-II-66.
565. *Morys valerius valerius* (Moeschler, 1878).
Fercal 1♂ 25-II-66.
566. *Morys subgrisea subgrisea* (Mab., 1897).
SobrdW 1♂ 22-II-66; Leop 1♂ X-37, 1♂ 1♀ XI-37, 2♀ XII-37; Arag 1♀ II-30; K222 1♂ 20-II-66.
567. *Cumbre belli eberti* Evans, 1955.
SobrdW 1♂ 24-II-66.
568. *Vettius phyllus phyllus* (Cr., 1777).
Camp 2♂ 2-I-36 (OC); Vian 1♂ II-30, 1♂ III-30.
569. *Vettius lafresnayei pica* (H.-Sch., 1869).
JZool 1♂ 8-VI-66 (KB).
570. *Vettius artona* (Hew., 1868).
PGama 1♂ 9-VI-66 (KB).
571. *Vettius marcus marcus* (F., 1787).
SobrdR 1♀ 22-II-66; SobrdW 1♀ 24-II-66; Contagem 1♂ 2♀ 23-II-66; Fercal 3♂ 25-II-66.
572. *Justinia phaetusa phaetusa* (Hew., 1866).
K222 1♀ 20-II-66 (KB).
573. *Naevolus orius orius* (Mab., 1883).
PPW 1♂ 27-II-66.
574. *Talides alternata alternata* (Bell, 1941).
Maranhão 1♂ 12-VI-66 (KB).
575. *Synale metella* (Plötz, 1882).
Leop 1♀ XI-37.
576. *Carystoides basoches basoches* (Latr., 1824).
PPW 2♂ 27-II-66 (1 with KB).
577. *Perichares philetes adela* (Hew., 1867).
JZool 2♀ 21-II-66, 3♂ 8-VI-66; Vead 1♂; Anap 1♀ XII-35; PPW 1♂ 19-II-66, 1♂ 27-II-66.
578. *Saturnus saturnus servus* Evans, 1955.*
Goiânia 1♂ 30-I-62, 1♂ 6-III-63.
579. *Quinta locutia* (Hew., 1876).*
SobrdR 1♀ 22-II-66; JZool 1♂ 21-II-66.
580. *Cynea irma* (Moeschler, 1878).
Fercal 1♂ 25-II-66.
581. *Cynea diluta* (H.-Sch., 1869).
SobrdW 1♂ 24-II-66; JZool 2♀ 21-II-66.
582. *Conga chydaea* (Butl., 1870).
SobrdW 1♂ 24-II-66; Fercal 1♂ 1♀ 25-II-66; JZool 1♀ 21-II-66; Leop 1♂ XII-37; PPEflex 2♀ 27-II-66.
583. *Hylephila phyleus phyleus* (Drury, 1770).
PPEflex 1♂ 7-VI-66.
584. *Polites vibex catilina* (Plötz, 1886).
JZool 1♀ 21-II-66; PPEflex 1♂ 19-II-66, 1♀ 27-II-66.
585. *Wallengrenia premnas* (Wallengr., 1860).
SobrdR 1♀ 22-II-66.
586. *Pompeius pompeius* (Latr., 1824).
Fercal 2♂ 23-II-66, 2♂ 25-II-66; JZool 1♂ 1♀ 21-II-66, 1♂ 8-VI-66; Camp 1♂ III-30; PPEflex 1♂ 1♀ 19-II-66, 1♀ 6-VI-66.

587. *Pompeius postpuncta* (Draudt, 1924).
BrasCC 1♂ 11-VI-66 (KB).
588. *Pompeius amblyspila* (Mab., 1897).
BrasCC 1♂ 11-VI-66 (KB); Leop 1♀ XII-37; K485 1♂ 26-II-66; K222 1♂ 20-II-66.
589. *Lerodia eufala eufala* (Edw., 1869).
JZool 1♀ 22-II-66.
590. *Lerodea erythrostictus* (Prittw., 1868).*
SobrdW 1♀ 12-VIII-65; Leop 1♂ III-38; K222 2♀ 20-II-66.
591. *Vacerra bonfilius bonfilius* (Latr., 1824).
Vian 1♀ III-30.
592. *Panoquina ocola* (Edw., 1863).
Camp 1♂ I-38; Arag 1♀ II-30; PPW 2♂ 27-II-66.
593. *Panoquina hecebolus* (Sc., 1872).
JZool 1♂ 8-VI-66 (KB); PPW 1♂ 1♀ 27-II-66.
594. *Panoquina chapada* Evans, 1955.
SobrdW 1♂ 22-II-66; JZool 1♂ 21-II-66; BrasCC 1♀ 11-VI-66 (KB); K485 1♂ 26-II-66.
595. *Panoquina sylvicola* (H.-Sch., 1865).
SobrdW 1♂ 24-II-66; Contagem 1♂ 1♀ 23-II-66; JZool 3♂ 1♀ 21-II-66; Cav 1♂; Leop 1♀ XI-37, 1♀ III-38; Arag 1♀ II-30; PPW c 19, 27-II-66.
596. *Panoquina bola* Bell, 1942.
SobrdR 1♂ 22-II-66; JZool 2♂ 21-II-66.
597. *Nyctelius nyctelius nyctelius* (Latr., 1824).
JZool 1♂ 21-II-66.
598. *Thespieus dalman* (Latr., 1824).
Fercal 1♂ 25-II-66.
599. *Niconiades xanthaphes* Hbn., 1821.
PPW 2♂ 19-II-66, 1♂ 27-II-66.
600. *Aides epitus epitus* (Stoll, 1781).
Vead 3♂.
601. *Xeniades orchamus orchamus* (Cr., 1777).
SobrdW 2♂ 11-VIII-65, 1♂ 13-VIII-65, 1♂ 1♀ 22-II-66, 2♂ 24-II-66; Contagem 1♂ 23-II-66.
602. *Xeniades chalestra chalestra* (Hew., 1866).
SobrdW 1♂ 1♀ 22-II-66, 1♂ 24-II-66.
603. *Saliana longirostris* (Sepp, 1848).
JZool 1♀ 21-II-66, 1♂ 22-II-66.
604. *Pyrrhopygopsis socrates socrates* (Mén., 1885).
Vead 2♂.

We expect the number of Hesperiinae to at least double from the present 71, perhaps reaching more than 150. Among the additions should be the following species, already known from the area: *Callimormus alsimo, Vidius finta, Vehilius gorta, Synale elana elana, Perichares lotus, Mellana perfida, Mellana clavus, Calpodes ethlius, Oxynthes corusca,* and *Thracides cleanthes cleanthes*. Although many more species are known from Mato Grosso or Minas Gerais, there is little information available about them and often only a few specimens known.

We also have three or four species of *Corticea* (Hesperiinae) that will require a revision of the genus; five new species of Pyrginae; and about

15 new species of Hesperiinae. The first 17 of these will be published shortly, as part II of this series (Mielke, 1967).

Total for Hesperiidae: 229. Predicted to occur in planalto: approximately 370 species, therefore about 62% of the total represented at present.

Total species at present: 628. Total estimated: 984, therefore about 64% represented at present.

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MITES FROM NOCTUID MOTHS

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My purpose in this paper is to introduce some of the mites that I have found on noctuid moths, and to enlist the help of lepidopterists in learning more about them. Until recently most of these mites were undiscovered or undescribed. Little or nothing is known about the biology of most of the species, and it is possible that when we know more, the mites may provide some interesting information about the moths that are their hosts.

One of the oldest names in acarology is that of a mite first found adhering to the wing of an unidentified moth. It was figured and described in *The Naturalists's* [*sic*!] *Miscellany* in 1794, as *Acarus lepidopterorum.* "This remarkable insect," as its discoverers described it, is now known as *Cheletomorpha lepidopterorum* (Shaw and Nodder). As far as I know, it has never again been found upon a moth, though it is a well known predator upon mites of other species.

Almost every collector of Lepidoptera has seen moths or butterflies bearing one or more tiny, orange-red, sack-like objects upon their bodies or appendages. Magnification of these objects shows three pairs of long, setose legs, often extended posteriorly and free of contact with the host. Attachment is by a set of mouthparts firmly implanted in the host's body. These parasites are the larvae of mites belonging to the trombidiform family Erythraeidae, distantly related to the chiggers. In a few days, the larvae become engorged with the hemolymph of the moth. They then drop off and complete their complex development amid low vegetation at or near the soil surface. The Nearctic species of erythraeids have been little studied and are not well known. They do not seem to be specific with regard to host species or site of attachment. One may find them on any part of the insect's body—on a wing vein, on an antenna, or even on the surface of a compound eye. As a rule there are only one or a few on a single host, but I have taken a female of *Eurois astricta* Morrison carrying at least 32 of them.

Unlike the larval erythraeids, which are conspicuous because of their exposed position, most moth mites are well hidden and seldom seen. There are very few published records of them. Except for one species which I shall mention later, their incidence on a given species of host, in my experience, is lower than ten percent. Yet, not counting the al-

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[1] With minor modifications, this is a paper that was presented at the 17th Annual Meeting of The Lepidopterists' Society at Ottawa, Canada, on 31 May 1966.

most ubiquitous erythraeid larvae, mites have been found on moths of more than 135 species belonging to many different families. The mites are easiest to find on fresh or living moths and on relaxed specimens, but can also be discovered on specimens long since spread and dried. Some species move about on their hosts. One may discover them on the neck, behind the front leg bases, under the tegulae, or where the thorax joins the abdomen. Other species prefer certain definite sites on the host. I shall discuss some of the mites that I have found on adult noctuids in three of the most favored locations: under the base of the proboscis, on the collar, and in the ears.

The proboscis of a noctuid moth is virtually a retractable gangplank. Flanked by the palpi, its base is also an ideal hideout for a stowaway mite. It is not surprising, then, to find that this spot may be occupied, sometimes by a single mite, sometimes by several. The search for mites on a freshly collected noctuid is best preceded by brief exposure of the insect to carbon dioxide or sublethal exposure to a killing agent which will leave the moth in complete relaxation. The insect is then grasped by the upraised wings with light, self-closing forceps (a trimmed-down spring clothespin will do), and placed under the low power of an entomological microscope. Passive extension of the tongue exposes any interpalpal mites that may be present. These can be picked up and transferred to alcohol by means of an insect pin which has been moistened or coated with petroleum jelly at its tip.

In twelve moths out of thousands examined in this way, I have found between the palpi the peculiar, non-feeding and mouthless nymphal stages of mites representing various species of the suborder Acaridei. These immature forms are variously known as travellers, wandernymphs, or "hypopi." They are strictly phoretic; that is, they use the moth as a vehicle only, rather than as a source of food. They are usually inactive, and may be attached to the host by ventral suckers. Many kinds of insects carry hypopodal mites, some more or less regularly. Under conditions favorable to further development, the travellers leave the host and eventually transform into adults. My specimens have not yet been determined, but among their hosts were four species of *Acronycta*, two of *Charadra*, one of *Graphiphora*, one of *Catocala*, and one of *Zale*, all from eastern United States. The mites are probably not restricted to noctuids as hosts, and perhaps not even to Lepidoptera.

The palpal bases of noctuids sometimes conceal larger mites of various species representing the more primitive suborder Mesostigmata. For some of these mites, to be mentioned later, the interpalpal region is merely a place to wait until the gangplank is lowered for debarkation; their main quarters on the moth are elsewhere. The other species that

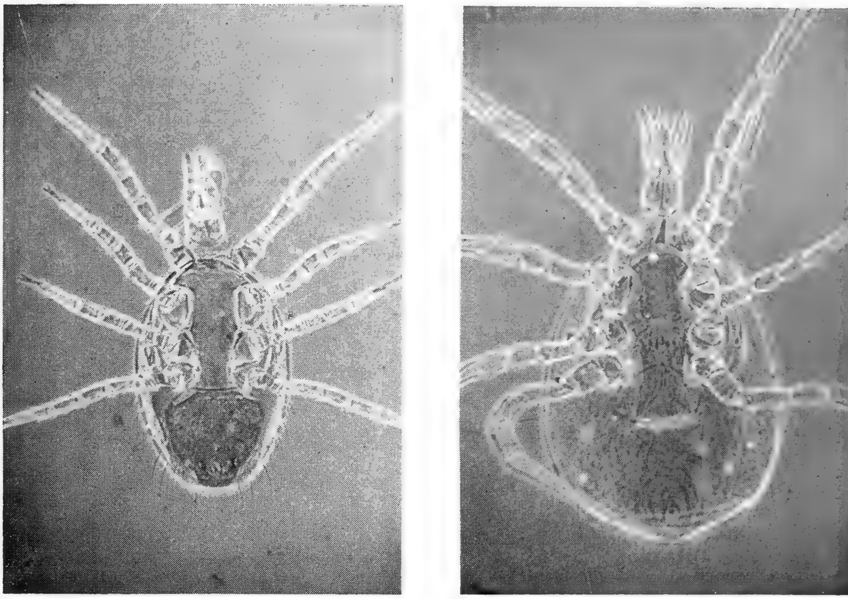

Fig. 1. *Blattisocius patagiorum* Treat, an ascid mite found on the thorax of *Pseudospaelotis haruspica* (Grote) and other noctuid moths. Phase contrast photomicrographs of cleared and mounted specimens. Left, male; right, female. Magnification (as printed) about 80×.

I have found between the palpi have usually not been seen on any other part of the insect. Such mites have appeared on 19 moths of 13 species: six of *Acronycta*, one of *Amphipyra*, three of *Catocala*, two of *Zale*, and one of *Zaleops*. One of these, *Zaleops*, was collected in Tucson, Arizona, the remainder in Massachusetts and New York. There are probably about seven species of mites in my series, at least six of which appear to be undescribed. All of the specimens are adult females of the family Ascidae, representing the genera *Lasioseius* and *Proctolaelaps*. Known species of *Proctolaelaps* have been found on insects of many kinds. One was described by Lyonet in 1760, from the caterpillar of the goat moth, but so far as I know none has previously been reported from adult moths of any species.

It is an open question whether these interpalpal ascids are to be considered as parasites or as phoretics. I have never caught one in the act of feeding, but in the soft cuticle of the moth's neck or in the retrocoxal region of the prothorax there are often small punctures, plugged with black, coagulated hemolymph. Punctures of this kind are characteristic feeding scars of mites that are known ectoparasites. Lindquist and Evans

(1965) state that "No ascid mites are known to be truly parasitic." Many are believed to be predators on other mites and small arthropods, or upon their eggs, larvae, or nymphs. It should be noted that the moths listed above as hosts include several that probably rest during the day on or under the bark of trees, a habitat often rich in mites of many kinds, including ascids. It may be that for the mites in question, phoresy on moths is only occasional or even accidental rather than obligatory. Against this view is the apparent preference of the *Lasioseius* and *Proctolaelaps* species for the interpalpal region, which suggests some degree of regularity in the association.

In contrast with the interpalpal mites in its choice of residence is another ascid, of the genus *Blattisocius* (Fig. 1). It occupies the dorsal surface of the thorax, on or near the patagia (Treat, 1966). It has appeared on five specimens of *Spaelotis clandestina* Harris, on two of *Graphiphora haruspica* (Grote), and on one each of *Apamea lignicolora* (Guenée) and *Amphipyra pyramidoides* Guenée, all common noctuids that typically hide under loose bark or in the crevices of buildings. Three of the hosts (*S. clandestina*) were taken in Giles County, Virginia, the others in Tyringham, Massachusetts. The adult mites are easy to spot. Their yellow posterior portions protrude from among the hairs and scales on or behind the host's patagia or on the anterior portion of the thoracic disc. In the summer of 1965 I was lucky enough to find some of these mites on a moth that subsequently lived for more than two months in a plastic petri dish where I was able to watch the mites under the microscope. I saw them mate and lay their eggs, and I followed their development through all stages. One of the hosts of this mite, *Graphiphora haruspica*, holds the record for harboring the greatest variety of stowaways of any noctuid. Mites of eleven species have been taken from various specimens of this moth.

The interpalpal and patagial mites already mentioned were regularly found in the places indicated, and not elsewhere. Some species of noctuid stowaways seem to be less selective. These include three known species of *Blattisocius*, the laelaptid mite *Androlaelaps casalis* (Berlese), and a few others. I shall not take time to discuss them here.

The most interesting mites of all are those that live in the ears. The noctuid ear or tympanic organ is a fascinating and beautiful thing in itself. Unknown until 1877, and almost completely neglected until its rediscovery by Eggers in 1911, it remained a puzzle to entomologists until recent years. It is now recognized as a superbly sensitive detector of the ultrasonic voices of insect-eating bats and perhaps of other predators (Payne et al., 1966). It has also gained attention, chiefly through the work of Kenneth Roeder, as an ideal subject for the study of the

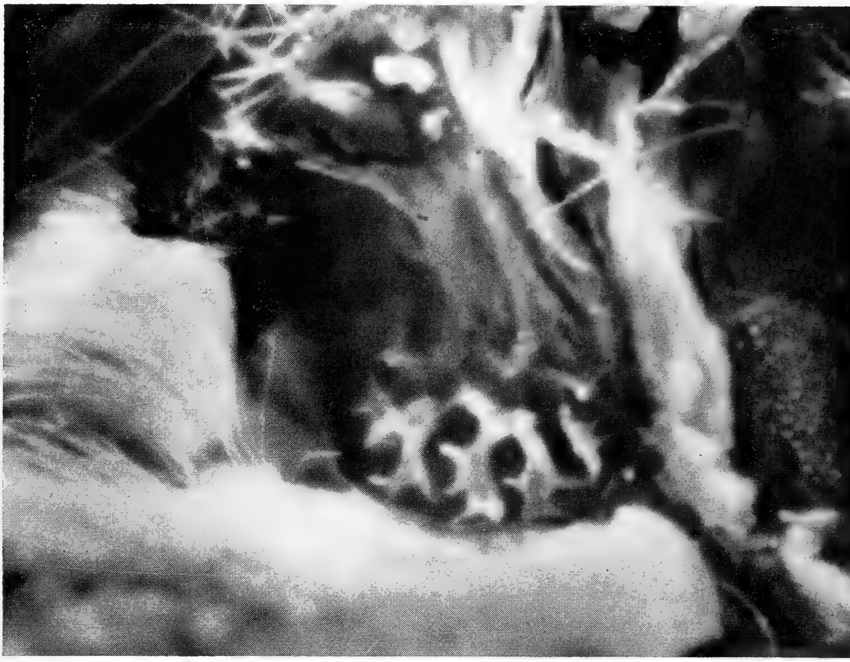

Fig. 2. *Lacinipolia m. meditata* (Grote). Left tympanic area. The pale, antler-like objects to the right of center are cuticular outgrowths of the nodular sclerite or epaulette, which forms the lateral border of the tympanic frame. They screen the tympanic membrane (dark areas between the "antlers"), and at least in some instances protect it from mites.

nervous mechanism in a simple form of acoustically activated behavior (Roeder, 1966).

The essential part of the tympanic organ is a thread-like sensillum, attached at one end to a thin cuticular membrane and containing a single pair of sensory neurons. This sensillum is suspended in hammock fashion within the tympanic air sac. Two round, membranous windows bear upon the air sac from the exterior. These are the tympanic membrane with its attached sensillum, and the countertympanic membrane, which apparently is not innervated. The tympanic membrane is set in a deep, scale-free recess in the metathorax at the base of the hind wing. The countertympanic membrane is roofed by an eggshell-shaped countertympanic cavity, which extends rearward into the first abdominal segment and has an oval or slit-like opening to the exterior just above the tympanic recess. The hood, a lateral projection of the first abdominal pleura, forms the posterolateral border of the tympanic recess and is anatomically analogous to the pinna of the human ear.

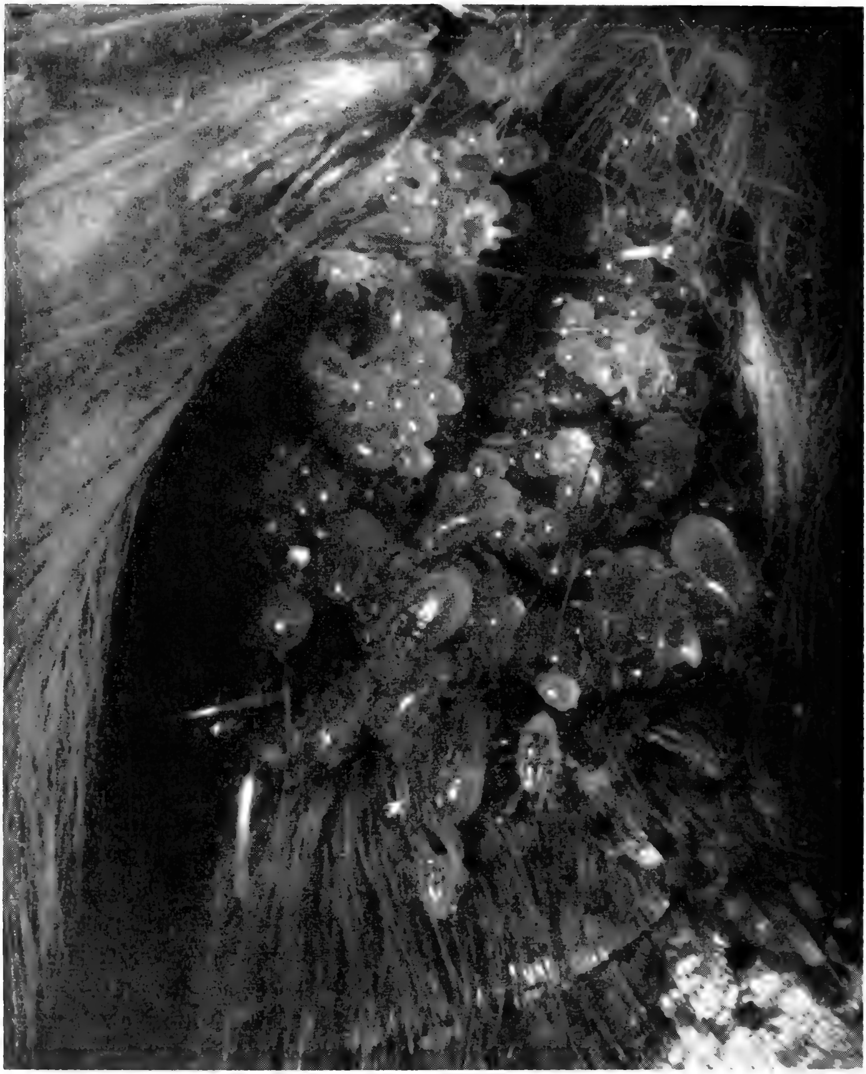

Fig. 3. Living colony of the moth ear mite *Dicrocheles phalaenodectes* in the right tympanic area of a female armyworm moth, *Pseudaletia unipuncta* (Haworth). Several gravid females are visible, together with larvae, nymphs, and eggs. The upraised hind wing of the moth appears at the upper right of the photograph, the abdomen at the left. Photo by Dr. A. B. Klots, reprinted with permission of the Journal of the New York Entomological Society.

In many noctuids the tympanic recess is more or less hidden from view by long, hair-like scales projecting rearward from above the hind leg base. In a few species, unrelated to one another (*e.g.*, *Acronycta*

hamamelis Guenée, and *Lacinipolia olivacea* (Morrison)), the lateral border of the tympanic membrane bears a heavily sclerotized, thorny, hedge-like outgrowth (Fig. 2) screening the tympanic membrane (Treat, 1956). Eggers (1936) referred to this structure as "*das Trommelfell-schutzgitter*," literally, "the drum membrane protection screen," and speculated that it could serve as a barrier to foreign objects. This structure is not of common occurrence, and in most species the tympanic membrane is screened only by easily displaceable hairs.

Except for the interpalpal, post-patagial, and subtegular areas, the tympanic recesses and the countertympanic cavities are the only readily accessible, scale-free parts of the body surface. Like the ears of hairy mammals and the nasal passages of birds, they offer attractive berths for stowaways, and they can be made to yield a free meal as well.

Three kinds of mites are known to take advantage of these accommodations more or less regularly (Treat, 1954, 1955b, 1961). Their discovery was the chance result of my rather clumsy efforts, in the early 1950's, to learn something about the function of the tympanic organ. For this purpose I had to examine the ears of a great many moths, both living and dead. It was almost inevitable that in this process I should eventually come upon some ear-dwelling mites.

The first species that I shall mention, though the latest to be described, is a minute red mite belonging to the family Tydeidae. This species was originally described as *Pronematus pyrrohippeus*, but it seems to belong to a new genus, *Pronematulus*, proposed by E. W. Baker (1965). This mite is so small that it would be possible to pack a thousand of them into one ear of a moth, although five or six are the most I have found there, and usually only one or two. So far, only 43 specimens have been discovered, and of these, seven were lost in experimental procedures. Their hosts, all collected at Tyringham, Massachusetts, comprised 23 moths of 11 species, the most frequent being *Apamea lignicolora* and *Graphiphora haruspica*, each with five cases of infestation. With one or two exceptions, all of these mites, when first seen, were resting quietly in the tympanic recess, often on the tympanic membrane itself. Sometimes they seem to be unattached, while in other instances they adhere to the moth's cuticle as though by a posterior ventral sucker. They are not readily disturbed, but once aroused they move rapidly and may quickly lose themselves in the vestiture bordering the ear. Some specimens have stayed for several days in the same position within the ear. Twice I have found single eggs of this mite on a tympanic membrane, and from one of these eggs, after six days, there emerged a living larva, the only one so far known. One or both ears may harbor the mites, but so far no sign of damage to the host has been seen.

The nearest relatives of *P. pyrrohippeus* are known to be predators of other species of mites or their eggs, and this, of course, suggested phagophily as a possible type of association in *P. pyrrohippeus.* As phagophiles, these little tydeids might be awaiting a chance to attack some other kind of stowaway on the same moth. Yet despite one appearance of a *P. pyrrohippeus* among ear-dwelling mites of another species, I am inclined to think that their usual relationship to their host is merely phoretic, and that they probably spend most of their lives as free-living predators.

The story is quite different with the moth ear mite, *Dicrocheles phalaenodectes* (Treat, 1954). Of the three ear-dwelling species now described, this was the first to be discovered, and is in many ways the most interesting. It was at first provisionally assigned to the laelaptid genus *Myrmonyssus* Berlese, but later became the type of a new genus, *Dicrocheles* Krantz and Khot (1962). Its family status, like that of many laelaptoids, is now in doubt. The first specimen came to me on a moth that flew into my attic laboratory in Tyringham in 1952 and practically presented its ears for inspection. It was one of those furry insects called "False Wainscots," *Leucania pseudargyria* Guenée. The moth's right ear was normal, but in its left ear were several round, white eggs looking like tiny pearls. When one of these eggs produced a living larval mite, I became interested. Soon another infested moth appeared, and before long it was evident that in moths of the genus *Leucania* and related genera, these mites were fairly common. The question was, were they of strictly local distribution? Moths in the study collection of The American Museum of Natural History soon gave the answer: the mites, or very similar ones are to be found around the world (Treat, 1955a). If they had not been discovered previously, why not? Was it because lepidopterists had rarely concerned themselves with moth ears, or because, having seen the mites, perhaps many times, they thought them not worth reporting? I do not know. At any rate the mites are there, and during midsummer of a favorable year as many as 90 percent of the moths of a favored species may harbor them. In Tyringham, during the five-year period from 1953 through 1957, I found 569 infested moths. In the three genera, *Leucania, Aletia,* and *Pseudaletia,* this total represented an overall incidence of 31.3 percent for the moths examined (Treat, 1958b).

Unlike the mites mentioned earlier, *Dicrocheles* develops large colonies on its host, destroying the occupied ear as a sense organ (Fig. 3). A mature colony may comprise more than one hundred active mites and nearly as many eggs. During midsummer, the entire life cycle may take as little as five days. The eggs hatch in about 48 hours, and the six-legged larvae soon begin feeding through the delicate tracheal epithelium

of the tympanic air sac. Their mother has prepared the way for them by perforating the tympanic and countertympanic membranes. She may lay her eggs in the air sac itself, or in the outer recess, or in both places. The first eggs often develop into males, which do not undergo the second nymphal stage and are ready to copulate with unmated females as they become available (Treat, 1965). In a large colony, all three chambers of the ear are filled to overflowing with mites and their eggs.

Such a colony has social problems. Defecation is restricted to two places: the rearmost end of the countertympanic cavity, and the outer rim of the external tympanic recess. In the latter place the liquid fecal droplets are deposited on the screening hairs and scales, which gradually become matted into a sort of thatch that loosely covers the recess. In the countertympanic cavity, the feces, as they dry, form a waxy or gummy plug with which are mingled many cast skins.

Copulation takes place chiefly in the countertympanic cavity, where mating pairs often can be found. Males comprise fewer than ten percent of the inhabitants. Even if the host dies they usually do not leave the ear. Several adult females may contribute to the colony, either from its initiation or after the first brood has developed. As the population pressure increases, some of the maturing and fertile females must find a new home.

Here is one of the most remarkable things about these mites. An easily available home—the contralateral ear—is ready and waiting only a short distance away, but it is almost never occupied. Experimentally, one can induce the mites to form bilateral colonies, but in nature this does not happen once in a thousand times. Instead, the young females make their way to the collar and dorsal side of the moth's neck, where, temporarily, they may do some feeding. As the moth's evening flight period approaches, the mites assemble a few at a time between the palpi, and when a flower is visited they disembark, using the tongue as a gangplank or sometimes just going "over the rail." From the flower, these wanderers may board another, less crowded moth, but no matter how many *Dicrocheles* re-embark on a single insect, all proceed, apparently by a more or less fixed route, to a single ear, and however large the colony may become, the opposite ear is left unoccupied and undamaged (Treat, 1957, 1958a, 1962).

Such one-sidedness is obviously not out of consideration for the moth. The mites, too, have something to gain by it. To a hungry bat, a fat noctuid is no less attractive for having an earful of *Dicrocheles*, and a totally deafened moth has less than an even chance of escaping capture. Plainly there is adaptive value for the mites in their habit of unilaterality.

The social life and behavior of the moth ear mites make a fascinating

study. At times a mature female in the presence of others exhibits a peculiar side-to-side shaking movement, curiously reminiscent of the wagging dance of the honey bees. The significance of this dance is not quite clear; it may be a signal of some kind, perhaps to bring about the dispersal of the young females.

There are other problems. Where are the moth ear mites during a northern winter when few if any adult moths of the host species are about? Why is it that at least in the type locality, the incidence of infestation drops so sharply from its peak in mid-July to a mere trickle through most of August and September, although available hosts are still on the wing? Despite its apparent preference for hadenines of the *Leucania* group, *Dicrocheles* has been taken from moths of no fewer than 74 species representing at least five noctuid subfamilies, chiefly the Agrotinae, the Hadeninae, and the Cuculliinae, with occasional records from the Plusiinae and very rarely from the Acronyctinae. Other groups seem to be immune.

There is one more mite that I should like to mention briefly. Its name is *Otopheidomenis zalelestes* (Treat, 1955b). It was discovered during a search of museum specimens in quest of ear-dwelling mites. As its specific name suggests, it was found on moths of the genus *Zale*, and has so far appeared nowhere else. I have seen 43 infested moths, representing nine species of this genus. The known distribution includes eastern United States, Central America, and the Antilles. The incidence in most of the museum series examined was not above five percent. Only one adult mite of this species has been seen alive; to my surprise, it was bright green, no doubt the color of its host's hemolymph. This mite became the type of a new genus and family, the Otopheidomenidae, now regarded by many acarologists as a subfamily of parasitic phytoseiids, which are normally plant-dwelling predators or general feeders.

The name *Otopheidomenis* means "one who spares the ear." It alludes to the mites' habit of laying eggs in the tympanic recess and under the hood, but leaving the sensory structures uninjured. The larvae, upon hatching, evidently creep out of the ear and up to the crested vestiture of the thoracic notum, where their remains and cast skins can be seen even on long-dried specimens. The later stages, including adult males and females, are most often found under the tegulae. The colonies are never very large, perhaps 20 at the most. The point of special interest is that in contrast with *Dicrocheles*, which is destructive but unilateral, *Otopheidomenis* injures neither ear, but occupies both!

The spectrum of mites inhabiting moths presents all shades of host dependency, from the occasional, probably temporary, and perhaps chance association of, say, a *Blattisocius*, to the obligatory, semi-internal, and

host-selective parasitism of *Dicrocheles*. Here is a garden of wonders for the inquiring lepidopterist, a garden that is virtually unexplored. I have only hinted at some of the problems that invite attention. Some of these can be illuminated only by the collective experience of many observers, both here and abroad. I invite you to join in this coöperative venture, and welcome your questions, criticism, and correspondence.

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RECENT ADDITIONS TO THE LEPIDOPTERA COLLECTION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

During the past several years the Lepidoptera collection of the American Museum of Natural History has been rapidly enlarging. At the present time it contains approximately 1,500,000 specimens; its size has increased two and one-half times since 1949. In recent years the emphasis has been on building up the North American macrolepidoptera; this section is now the best of any museum in the world.

In the past few years several important collections have been received, and they are briefly described below. Each of them has been incorporated into the Lepidoptera collection of the Museum.

The Alexander Chnéour collection of Tunisian macrolepidoptera. This gift consisted of 806 specimens, representing the cream of 25 years' collecting in this north African country by Mr. Chnéour. The collection contains about 95% of the described forms from Tunisia, and it is said to be the most complete one ever assembled. In the course of his studies on the Tunisian fauna, Mr. Chnéour published a number of papers and described several new species, subspecies, and forms; these types are in his collection. They are in the Pieridae (four taxa), Satyridae (four), Noctuidae (one), and Lasiocampidae (two).

The A. C. Frederick collection of North American macrolepidoptera. This gift consisted of 6459 specimens. The material was not only from the Albany, New York area, where Mr. Frederick lives, but is transcontinental in scope, as Mr. Frederick collected in eastern Canada and in many parts of this country. This collection had more than 700 specimens from the John H. Cook collection, including some of the original *Incisalia* specimens described by Cook.

The William H. Howe collection of 7374 specimens. Of these, 6381 were from North America, and 993 were exotics. This collection was one of the largest ever made in Kansas, and it had both butterflies and moths. This gift included the holotype of *Ceratomia kansensis* Howe and Howe (Sphingidae).

The Mariana Ibarra collection of Spanish Lepidoptera. This magnificent collection of 12,546 specimens (5171 butterflies and 7375 moths) was purchased by friends of the Department of Entomology. It was one of the most complete collections of Lepidoptera ever made from Spain and the adjoining countries, and the individual specimens are in excellent condition and are beautifully mounted.

The Alexander B. Klots collection of Pieridae. This fine gift of 3468 specimens, including 77 paratypes, represented a world-wide collection of this family. Much of this material was used by Dr. Klots in his revisionary studies of the group; a large part of it was collected by him in northern Canada and in the Rocky Mountain states.

The field trips of Frederick H. Rindge, supported by National Science Foundation grants G-9037, G-25134, and GB-3856. During the past eight years, with the assistance of my wife Phyllis and daughters Barbara (1959, 1960), Janet (1961), and Marguerite (1962–1966 inclusive), we have collected 97,199 specimens of Lepidoptera, primarily in Wyoming, South Dakota, Colorado, Utah, Nevada, Arizona, and New Mexico. Our largest collections were made in New Mexico (3991 butterflies and 27,924 moths), Utah (2406 butterflies and 23,346 moths), Wyoming (4976 butterflies and 12,585 moths), and Nevada (1155 butterflies and 12,539 moths). This material has all been mounted and incorporated into the collection.—Frederick H. Rindge, *The American Museum of Natural History, New York, N. Y.*

TYPE LOCALITIES OF SOME NEOTROPICAL LYCAENIDAE TAKEN BY GERVASE MATHEW AND DESCRIBED BY W. C. HEWITSON

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Hewitson (1874) described eight species of neotropical lycaenids. Following his common practice he gave only the country of origin of these specimens (Mexico, Panama, Peru, or "Chili") and ordinarily any further precision of type localities would have to be arbitrary.

In this instance, however, it seemed possible that further information on the actual localities of origin of the specimens might be obtainable, for in his prefatory remarks Hewitson states that they were taken by "Mr. Gervase Mathew, of the Royal Navy, who collected them during a cruise by H. M. S. 'Repulse' in the Pacific." Some record of the movements of the "Repulse" should, it seemed, be on file with the Admiralty and such a record might make it possible to restrict the localities.

I therefore addressed an inquiry to the Naval Librarian, Ministry of Defense, London. The reply I received, from Miss Vivienne S. Heath, was most helpful. Miss Heath abstracted the relevant portions of the published précis of the movements of the "Repulse" and even though she apologizes for the brevity and occasional lapses of detail in this account, it still provides an accurate record and gives about all the relevant information that could be expected. In only one place did it fall short: the leg of the voyage from San Francisco to Mazatlán, critical for one species (*Thecla critola*). Miss Heath suggested that the log itself (in the Public Records Office) should be consulted. Thanks to the précis, it was possible to request microfilm copy of only this part of the log, which I did.

In addition to furnishing the précis, Miss Heath also transcribed and sent the obituary notice of Mathew that appeared in the London *Times* for 17 February 1928. In this notice, mention is made of Mathew's journals, "which he kept continuously from 1861 until the beginning of his last illness in 1925, [and which] are full . . . of the scientific observations which he made in many countries." Unfortunately, all efforts to locate these journals have failed. My good friend, Mr. N. D. Riley, of the British Museum Department of Entomology (who also published an obituary of Mathew: Entomologist 61:119, 1928), to whom I wrote for help, checked all the possible repositories known to him, including the societies of which Mathew was a member, but found no trace of the journals.

For their much appreciated efforts in connection with this paper, I thank The Naval Library and Miss Heath; Mr. Riley; and the Public Record Office.

The "Repulse" left Great Britain in August, 1872, with Assistant Paymaster Mathew on board as clerk to the Admiral's secretary, headed for a routine program on the Pacific station. Proceeding by way of Madeira and Rio de Janeiro she rounded the Cape and put in at Valparaiso, Chile, on 27 October, staying there until about 18 February 1873. She then continued north to Coquimbo, Chile (20 February–6 March); Arica, Chile (15–22 March); Callao, Peru (29 March–17 April); Payta [Paita], Peru (late April–2 May).

From Paita she left for the Sandwich [Hawiian] Islands. The "Repulse" departed Honolulu on 27 June, headed northeast for Vancouver Island, and reached Esquimalt, near Victoria, on 26 July. There she remained until 4 November, when she departed for San Francisco, California.

On 19 November 1873 (our information now derived from the ship's log itself) she left San Francisco, continuing south, and put in at Bahía Magdalena (Baja California Sur, Mexico) on 25 November, staying less than eight hours. She then left, rounded Cabo San Lucas on 27 November and reached Guaymas (Sonora, Mexico) on 29 November. She departed Guaymas on 2 December, after two full days in port, and continued south, reaching Mazatlán (Sinaloa, Mexico) on 5 December, and stayed there until 11 December.

From Mazatlán (we resume with the précis), the "Repulse" continued southward to Acapulco (Guerrero, Mexico) (about 16 December 1873 to 18 January 1874), and Taboga (Isla Taboga, Panamá, in the Bahía de Panamá), which she reached on 6 March, remaining until 22 March. She then moved to Cd. Panamá, where she stayed until 18 May 1874.

Here, Mathew apparently left the "Repulse," and our interest in her further movements ceases (she continued south). Mathew must have crossed the isthmus and obtained passage on a homeward-bound vessel. However he did it, he made good time: about six months after he left the "Repulse" Hewitson's descriptions of his lycaenids were published!

It should be added that on several occasions the admiral shifted his flag to another vessel among the several that more or less accompanied the "Repulse," and departed on various side trips. He did so at Esquimalt; at Acapulco, to visit some of the ports of Central America; and again in Panamá, to visit ports along the north end of South America's Pacific coast. Although, as Miss Heath pointed out, Mathew might have gone on some or all of these side trips, there is no evidence that he did so

(or, if he went, that he did any collecting). All the countries mentioned by Hewitson were visited by the "Repulse" herself.

The following list of Hewitson's eight species of lycaenids includes remarks on their probable type localities, based on the above trip résumé. Where they are known I give current equivalents of his names. The page reference after each name refers to Hewitson's paper.

THECLA SEDECIA [*Strymon albata sedecia*], p. 105

Described from Mexico. The source of the material must be either Mazatlán or Acapulco, since the species does not occur on Baja California or as far north as Guaymas. There is no reason why it should not occur in the Acapulco region, but I know of no records. On the other hand, it was recorded from Presidio, near Mazatlán, by Godman & Salvin (1887: 94) and we took it in three different places near Mazatlán in 1961 (Cary-Carnegie Museum Expedition). In view of this, the following designation is made:

Type locality: here restricted to Mazatlán, Sinaloa, Mexico.

THECLA CHONIDA, p. 105

Described from Mexico. For the same reasons as the preceding, this must be from either Mazatlán or Acapulco. This poorly known species may turn out to be the female of *Strymon bebrycia* Hewitson 1869. We took the latter near Mazatlán, but I do not know if it occurs near Acapulco. With so little information, no further restriction is advisable at this time.

Type locality: either Mazatlán, Sinaloa, or Acapulco, Guerrero.

THECLA CYRRIANA, p. 105

Described from Peru. This is another poorly known species, but not surprisingly so, as the western coast of South America is hardly better known today than it was when Mathew collected there.

Type locality: either Callao or Paita, Peru.

THECLA CRITOLA [*Hypostrymon critola critola*], p. 105

Described from Mexico. The "Repulse" stopped at two localities within the range of this species, Bahía Magdalena on the peninsula of Baja California, and Guaymas, Sonora, on the mainland. Each of these areas is inhabited by a different subspecies and it is therefore important to identify the source of the type.

Although the "Repulse" stopped at Bahía Magdalena, it was a brief call of only a few hours and I doubt if Mathew did any collecting there

at all. The stop at Guaymas, however, lasted several days, time enough to take net in hand and do some exploring.

Guaymas, then, is the most likely source of the type of this species. Mr. G. E. Tite, Department of Entomology, British Museum, kindly compared the type of *critola* with other specimens of the species in the British Museum collection from Guaymas. I had sent Mr. Tite a list of the differentiating characters of the two subspecies and he found that the type agreed closely with specimens of known Guaymas origin and with the characters of the mainland subspecies.

The name *critola*, therefore, is restricted to the mainland populations, leaving the name *festata* Weeks (1891: 102) (TL, San José del Cabo, Lower California) for the peninsular subspecies.

Type locality: here designated as Guaymas, Sonora, Mexico.

THECLA MATHEWI, p. 106

Described from Mexico. The species apparently does not occur as far north as Mazatlán. A definite restriction is not made at this time.

Type locality: probably Acapulco, Guerrero, Mexico.

THECLA CYPHARA [*Electrostrymon endymion cyphara*], p. 106

Described from Panama.

Type locality: either Isla Taboga or Ciudad Panamá. I have no information from which to make a choice.

THECLA QUADRIMACULATA ["*Thecla*" *bicolor* Philippi], p. 107

Described from "Chili."

Type locality: Valparaiso, Coquimbo or Arica, Chile.

LYCAENA LYRNESSA [*Pseudolucia collina* Philippi], p. 107

Described from "Chili." The name is now considered a synonym of *Lycaena collina* Philippi (Nabokov 1945: 32).

Type locality: Valparaiso, Coquimbo or Arica, Chile. The species has been taken at both Valparaiso and Coquimbo (Nabokov, 1945).

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A REPORT ON TWO RECENT COLLECTIONS OF BUTTERFLIES FROM HONDURAS

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While employed with other endeavors in the Central American republic of Honduras, Monroe and Williams each made field collections of Rhopalocera. Williams was in Honduras as an employee of the United Fruit Company, and Monroe was there as an assistant to her husband, who was engaged in ornithological research.

Literature pertaining to the Lepidoptera of Honduras is scarce. The only extensive collections known to us were made by G. M. Whitely and E. Wittkügel and recorded in Godman and Salvin (1879–1901) or in Seitz (1923). Other than these two general works, records are limited to references in various reviews and revisions of groups of Lepidoptera.

In the collections of Monroe and Williams are 205 species of butterflies, including many previously unrecorded from the republic. Identifications were made by Ross with the assistance of various specialists. Several specimens that remain unidentifiable for various reasons are omitted from this paper and may represent further additions to the known Lepidoptera of Honduras.

Collecting Sites

The specimens were taken primarily in the departments of Cortés and Atlántida; a few others came from the departments of Yoro, Santa Bárbara, Comayagua, and Choluteca, and the Distrito Central. The following localities may be found by referring to the map (Fig. 1); numbers in brackets following place names correspond to those in Fig. 1.

1. Department of Cortés.

El Jaral [12] is a village on the northern end of Lake Yojoa at an elevation of about 2100 feet. The majority of specimens with this label were secured at *Finca Fé*, a coffee plantation one mile northwest of the village. This finca is an area of tropical rain and deciduous forest with the undergrowth cleared for coffee plantings. Most of the butterflies were taken along pathways in the forest, in clearings, or in adjoining fields.

Along the main road leading southward from San Pedro Sula is *Amapa* [11], location of one of the few remaining expanses of forest in that part

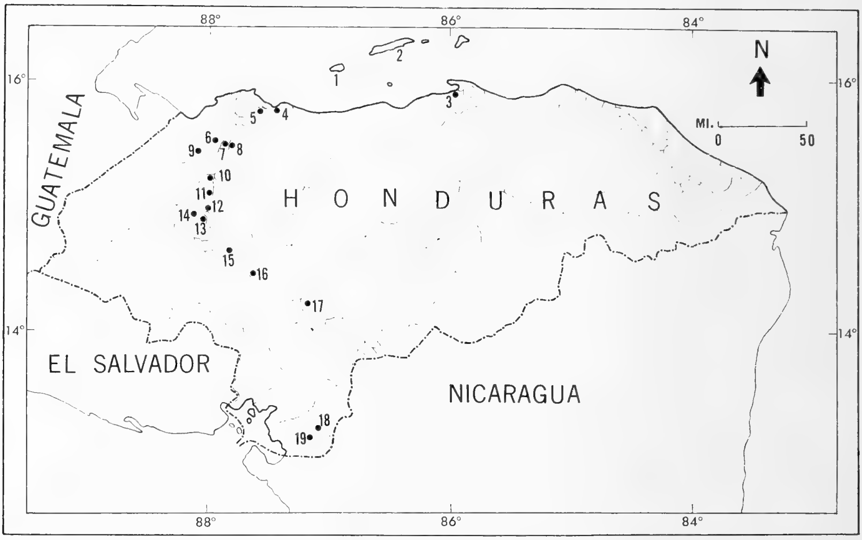

Fig. 1. Map of Honduras, showing localities mentioned in text. Numbers refer to the following: (1) Utila, (2) Ruatan [= Roatán], (3) Trujillo, (4) Tela, (5) San Alejo, (6) San Pedro Sula, (7) La Lima, (8) Progreso, (9) Cofradía, (10) Potrerillos, (11) Amapa, (12) El Jaral, (13) El Sauce, (14) Cerro Santa Bárbara, (15) Siguatepeque, (16) Comayagua, (17) Cerro San Juancito, (18) El Corpus, and (19) Namasigüe. (Map adapted from Monroe, 1965).

of Cortés. The gallery forest there is also partly deciduous. Amapa is about 13 miles south of Potrerillos and at an elevation of about 300 feet.

Potrerillos [10] is a town on the Sula (Ulúa River) plain and is surrounded by rather dry scrub country. Virtually all specimens with this label were taken south of the town along the road. In August and September, butterflies were congregated in numbers at roadside puddles.

San Pedro Sula [6] is the largest town on the Sula plain. Although rain forest was extensive in the years that Whitely and Wittkügel collected there, undisturbed forest exists now only on the hills and mountains overlooking the town on its western border. Our specimens were captured either in the town or in surrounding fields.

La Lima [7], the location of the Research Division of the United Fruit Company, is seven miles east of San Pedro Sula and also is nonforested. The butterflies from there were collected near the homes of company personnel.

Just west of La Lima lies *La Mesa*, a farm with meadows, some forest, and artificial plantings of bamboo. *Santa Rosa Farm*, six miles northeast of La Lima on the road to Progreso, is primarily pasture.

Guaruma #1, #2, and *#3* are banana farms, one, three, and five

miles west of La Lima, respectively. These and the preceding localities on the Sula plain are at about 150–250 feet elevation. Specimens from the Guaruma stations were taken in or near the scattered remaining forest.

Nine miles west of La Lima, just beyond Guaruma #3, is *Calán,* another semi-forested locality. Some of the specimens were taken in pastures, others on the forested hillside. North of Calán and one mile south of San Pedro Sula is *La Cumbre*, a site overlooking the Chamelecón River.

Cofradía [9] is a town in the Quimistán (Chamelecón) Valley and is 15 miles southwest of San Pedro Sula. The specimens from there were captured in open grassy fields.

2. Department of Santa Bárbara.

Cerro Santa Bárbara [14], on the western side of Lake Yojoa, is about five miles west of El Jaral. Butterflies were taken in low montane rain forest and along the forest edges. This forest represents a transition zone from tropical rain forest to cloud forest and contains flora and fauna typical of each.

El Sauce [13] is a village south of Cerro Santa Bárbara. The specimens from there were captured in grassy fields near the western shore of Lake Yojoa.

3. Department of Atlántida.

Along the Caribbean Sea, specimens were taken at the port of *Tela* [4]. All were flying on or near the beach. Three miles inland from Tela is *Lancetilla,* an experiment station of the United Fruit Company surrounded by dense tropical rain forest. Flowing from the hills above is a river that serves as the water supply for Tela. The highest elevation at which our specimens were secured was approximately 500 feet.

San Alejo [5], an African oil palm plantation of the United Fruit Company, also has a watershed in the nearby tropical rain forest. Williams' specimens were taken on the plantation, Monroe's in the forest. This locality is 10 miles west of Tela and is only slightly above sea level.

4. Department of Yoro.

Specimens were obtained only near the town of *Progreso* [8]. These were taken at an elevation of 200–500 feet on the hills east of the town.

5. Department of Comayagua.

Specimens were secured from an area of pine two miles south of *Siguatepeque* [16]. At that locality the elevation is about 4000 feet.

In the arid Comayagua Valley, the town of *Comayagua* [15] is situated at an elevation of 1900 feet.

6. Distrito Central.

Cerro San Juancito [17], as it is known to most naturalists, is a peak on the road to the silver mines near the town of San Juancito. It is located 10 miles northeast of the capital of Honduras, Tegucigalpa. Covering the mountain is a dense cloud forest that remains virtually undisturbed. Specimens were obtained at elevations from 6000 to 7000 feet.

7. Department of Choluteca.

On the Pacific slope in this department, specimens were captured at three localities. *El Corpus* [18], situated 1000 feet above the Choluteca Valley, is a town surrounded by forested hills. The specimens were taken in this monsoon (deciduous) forest, which is deceptively lush in the rainy season (September–October) and usually dry during the rest of the year. Southwest of El Corpus are the two other localities, *Namasigüe* [19] and *Palmerola.* Specimens from these two areas were taken in grassy fields with scattered trees, in primarily arid scrub, or in deciduous forest.

The three northernmost localities, two islands, *Utila* [1] and *Ruatan* [2], in the Caribbean and the port city *Trujillo* [3], are localities visited by previous collectors, to which reference is made in the text.

List of Specimens

In the following list of specimens, the species marked with an asterisk (*) have not been previously recorded from Honduras, although in most cases they are known to occur both to the north and to the south of the republic. There are few specimens listed for which the data are not complete: Lancetilla, Spring 1962 (RNW) and Department of Cortés, 10 Aug. 1962 (RSM). At Lancetilla between 15 Jan. and 15 May 1962, several specimens were captured for Williams by one of his assistants. The specimens collected on 10 Aug. 1962 were taken either at El Jaral or at Potrerillos, but the exact location was lost for several specimens obtained on that date. Unless otherwise indicated, all specimens were collected during 1962.

All specimens are currently retained in the private collections of Monroe (RSM) and Williams (RNW).

Papilionidae

Graphium philolaus (Boisd.).—Calán, 14 July 1961, 17 May; La Lima, 14, 15 May; 3♂♂, 1♀ (RNW).

Graphium protesilaus (L.).—Calán, 17, 25 May, 2♂♂ (RNW).
Graphium epidaus epidaus (Doubl., Westw. & Hew.).—Calán, 14 July 1961, 1♂ (RNW).
Battus polydamas (L.).—Calán, 25 May; Guaruma #2, 26 Oct. 1961; La Lima, 15 May; Progreso, 21 May 1961; Lancetilla, May, Spring 1962; 3♂♂, 3♀♀ (RNW). Potrerillos, 29 Aug., 1♂ (RSM).
**Battus belus varus* (Kol.).—Amapa, 15 July 1961, 1♂ (RNW). This species has been recorded from Guatemala and to the south of Honduras (Seitz, 1923). This individual was captured while it was flying 2–3 feet above the ground in gallery forest.
Parides arcas mylotes (Gray).—Lancetilla, 16, 18, 21, 23 June 1961, 2♂♂, 2♀♀ (RNW). Lancetilla, 19 Aug., 1♂ (RSM).
Parides iphidamas (Fabr.).—Lancetilla, 10, 11, 18, 26 June 1961, Spring 1962, 4♂♂, 1♀ (RNW). Lancetilla, 19 Aug.; El Jaral, 5 Nov.; 2♂♂, 1♀ (RSM). Assignment of this heterogenous group of specimens to this species is tentative.
**Parides lycimenes lycimenes* (Boisd.).—Lancetilla, 17 Aug., 1♂ (RSM).
Parides polyzelus polyzelus (Feld.).—La Lima, 5 Dec. 1961; Santa Rosa Farm, 19 Nov. 1961; San Alejo, 19 Nov. 1961; 2♂♂, 1♀ (RNW). El Jaral, 22 Sept., 1♀ (RSM).
Parides montezuma (Westw.).—Calán, 9 July 1961; La Lima, 14, 15 May; 1♂, 3♀♀ (RNW).
Papilio anchisiades idaeus Fabr.—Guaruma #1, 19 April, 10♂♂, 6♀♀, larvae; La Lima, 14 May, 1♀ (RNW). The nearly full-grown, gregarious larvae were taken from an orange tree. They fed nocturnally for about one week in captivity, then began pupating on 26 April. The adults emerged 9–14 May.
**Papilio polyxenes polyxenes* Fabr.—El Jaral, 12, 25 Aug., 23 Sept., 2♂♂, 1♀ (RSM).
Papilio thaos autocles Roth. & Jord.—Calán, 28 Aug. 1961, 17 May; La Mesa, 27 Aug. 1961; Lancetilla, 19 May; 3♂♂, 1♀ (RNW). El Jaral, 23 Sept.; Potrerillos, 29 Aug.; Cerro Santa Bárbara (3500′), 22 Nov.; 1♂, 2♀♀ (RSM).
Papilio victorinus victorinus Doubl.—El Jaral, 5 Nov., 1♀ (RSM).

PIERIDAE

**Dismorphia praxinoe* (Doubl.).—El Jaral, 7, 26 Aug., 4, 22 Sept., 3♂♂, 1♀ (RSM). This species was found flying low through the semi-open forest.
**Dismorphia fortunata* (Luc.).—El Jaral, 17 Sept., 1♂ (RSM).
**Enantia albania* Bates.—El Jaral, 9, 13, 14, 27 Aug., 17 Sept., 3♂♂, 2♀♀ (RSM). Two kinds of males are included here: two individuals are cream-colored with brown edging at the apex of the forewing; the third male is yellow with heavy orange suffusion and two small dark spots along the costal margin of the forewing in addition to the same brown marking on the apex. The females are yellow with more dark markings on the dorsal forewing than the two male forms.
**Leptophobia aripa elodia* (Boisd.).—El Jaral, 14, 23 Sept., 1♂, 1♀ (RSM).
**Pereute charops* (Boisd.).—El Jaral, 1, 5 Nov., 2♂♂, 2♀♀ (RSM). These individuals were taken in shaded forest.
Itabalia demophile calydonia (Boisd.).—2 mi. S El Corpus, 7 Oct., 1♂ (RSM). This male is the first specimen of this species from the Pacific slope of Honduras. Godman and Salvin (1879-1901) list specimens from San Pedro Sula and Ruatan, one of the Bay Islands. Monroe's specimen was captured as it flew along a trail in the monsoon forest.
Itabalia pisonis kicaha (Reak.).—Lancetilla (500′), 27 June 1961, 1♂ (RNW). This individual was taken in dense forest.
Ascia monuste monuste (L.).—La Lima, 15 March 1961, 13 Feb., 7 May; Lancetilla, Spring 1962; 3♂♂, 1♀ (RNW). Siguatepeque, 24 Aug.; Potrerillos, 29 Aug.; 5♂♂ (RSM). These specimens constitute the first mainland record for this

species; the previous Honduran record is from Ruatan (Godman and Salvin, 1879–1901).

Ascia josephina (Btlr. & Druce).—Calán, 9 July 1961, 17 May, 1♂, 1♀ (RNW).

Melete isandra (Boisd.).—Calán, 29 Oct. 1961, Spring 1962, 2♂♂ (RNW).

Anteos chlorinde (Godt.).—Calán, 17 May; Guaruma #2, 18 July 1961; 2♂♂ (RNW). El Jaral, 6, 13 Aug.; Potrerillos, 29 Aug.; 3♂♂, 1♀ (RSM).

Phoebis sennae marcellina (Cr.).—Guaruma #3, 17 July 1961; La Lima, 8 July 1961, 15 May; Lancetilla, 18 June 1961, Spring 1962; San Alejo, 21 April; 5♂♂, 1♀ (RNW). El Jaral, 6, 7, 12 Aug.; Potrerillos, 29 Aug.; 4♂♂, 4♀♀ (RSM). The San Alejo female is atypical; the ground color dorsally is yellow, like the males, and the markings are not as conspicuous as those of a typical female, either dorsally or ventrally.

Phoebis philea (Johan.).—El Jaral, 14 Sept.; Potrerillos, 10, 11, 29 Aug.; 4♂♂, 1♀ (RSM).

Phoebis argante (Fabr.).—Progreso, 21 May 1961; Calán, 17, 25 May; 4♂♂ (RNW). El Jaral, 12 Aug.; Potrerillos, 29 Aug.; 1♂, 1♀ (RSM).

**Phoebis agarithe maxima* (Neum.).—Guaruma #2, 18 July 1961, 1♂ (RNW).

Phoebis statira jada (Btlr.).—Calán, 25 May, 1♂ (RNW).

Eurema albula (Cr.).—El Jaral, 6, 8, 9, 13, 25 Aug.; Potrerillos, 10 Aug.; Lancetilla, 19 Aug.; 6♂♂, 3♀♀ (RSM). These specimens constitute the first Honduran mainland records for the species, which has been previously recorded only from Ruatan (Godman and Salvin, 1879-1901).

Eurema daira daira (Godt.).—Lancetilla, Spring 1962, 1♂ (RNW). Potrerillos, 11, 29 Aug.; Dept. of Cortés, 10 Aug.; Tela, 18 Aug.; Siguatepeque, 24 Aug.; 6♂♂, 2♀♀ (RSM).

Eurema boisduvaliana Feld. & Feld.—El Jaral, 6, 7, 8, 9, 13, 25 Aug., 16 Sept.; Potrerillos, 10 Aug.; 7♂♂, 3♀♀ (RSM).

Eurema proterpia (Fabr.).—La Cumbre, 14 May 1961; La Lima, 13 Feb. 1962; Cofradía, 3 Sept. 1961; 3♂♂ (RNW). El Jaral, 25, 27 Aug.; Tela, 18 Aug.; 4♂♂, 2♀♀ (RSM). The La Cumbre specimen is a tailed, dry season or winter form.

Eurema lisa Boisd. & LeC.—Potrerillos, 11 Aug.; Tela, 18 Aug.; 1♂, 1♀ (RSM).

Eurema nise nelphe (R. Feld.).—Potrerillos, 10 Aug.; Siguatepeque, 24 Aug.; 2♂♂, 1♀ (RSM).

Eurema dina westwoodi (Boisd.).—El Jaral, 25 Aug., 1♂ (RSM).

Eurema nicippe (Cr.).—Potrerillos, 10 Aug., 2♂♂ (RSM).

ITHOMIIDAE

Tithorea tarricina Hew.—Lancetilla, 10, 23 June 1961, Spring 1962, 3♂♂, 2♀♀ (RNW). Lancetilla, 17 Aug. 1962, 1♂ (RSM). Lancetilla is between Truxillo (= Trujillo) and San Pedro Sula, the localities from which specimens of two races of this species are recorded in Fox (1956).

Mechanitis polymnia lycidice Bates.—La Lima, 15 May; San Alejo, 19 Nov. 1961; Lancetilla, 10, 18, 23, 25, 26 June 1961, Spring 1962; 6♂♂, 8♀♀ (RNW). El Jaral, 7, 9, 12, 13, 14, 16, 17, 26 Aug., 4, 16, 23 Sept., 13♂♂, 12♀♀ (RSM). The La Lima specimens are the only ones that were not taken in rain forest or at its edge.

Mechanitis menapsis saturata Godm.—Lancetilla, 23 June 1961, Spring 1962, 1♂, 1♀ (RNW). El Jaral, 23 Sept., 1♀ (RSM).

Hypothyris lycaste diomaea (Hew.).—Lancetilla, 11 June 1961, 1♂ (RNW).

Napeogenes tolosa (Hew.).—El Jaral, 23 Sept., 1♂ (RSM).

**Ithomia patilla* (Stdgr.).—Lancetilla, 18 June 1961, 1♀ (RNW). El Jaral, 7, 14, 16 Aug., 4, 23 Sept., 3♂♂, 2♀♀ (RSM).

**Hyposcada virginiana virginiana* (Hew.).—El Jaral, 5 Sept., 1♂ (RSM).

**Aeria pacifica* G. & S.—Lancetilla, 2, 26 June 1961, 1♂, 1♀ (RNW).

Callithomia hezia hezia (Hew.).—Lancetilla, 27 June 1961, Spring 1962, 1♂, 1♀ (RNW).
Dircenna klugi (Geyer).—El Jaral, 7, 12, 13, 26, 27 Aug., 4, 16, 23 Sept., 6♂♂, 6♀♀ (RSM).
Dircenna euchytma (Feld.).—El Jaral, 16 Sept., 1♀ (RSM).
Pteronymia cottyto (Guér.).—Lancetilla, Spring 1962, 1♀ (RNW). El Jaral, 6 Aug., 1♀ (RSM).
Godyris sosunga (Reak.).—Lancetilla, 26 June, Spring 1962, 3♂♂ (RNW).
**Greta nero* (Hew.).—El Jaral, 16 Aug., 1♀ (RSM).
Greta oto (Hew.).—Lancetilla, Spring 1962, 1♂ (RNW). El Jaral, 6, 16, 26 Aug. 1♂, 5♀♀ (RSM).
**Hypoleria cassotis* (Bates).—Lancetilla (500′), 27 June 1961; Lancetilla, Spring 1962; 2♂♂, 1♀ (RNW). Seitz (1923) listed this butterfly from Guatemala and Panama.

Danaidae

Lycorea ceres atergatis (Doubl.).—Calán, 14 July 1961, 25, 26 May, 1♂, 2♀♀ (RNW). El Jaral, 7, 9 Aug., 1♂, 1♀ (RSM).
Danaus plexippus plexippus (L.).—La Lima, 5, 11 March, 14 May, 2♂♂, 1♀ (RNW). El Jaral, 21 Aug., 1 ♀ (RSM). The two La Lima specimens taken in March were reared in captivity and the dates represent those of emergence.
Danaus gilippus strigosus (Bates).—Calán, 25 May; La Mesa, 18 July, 27 Aug. 1961; La Lima, 20 Feb., 17 May; Lancetilla, 8 June 1961, 27 Jan., Spring 1962; 5♂♂, 3♀♀ (RNW). Tela, 18 Aug., 1♂ (RSM). These specimens represent the first mainland records for Honduras, since the species has been previously recorded only from Ruatan (Godman and Salvin, 1879-1901).
Danaus eresimus montezuma Tal.—Guaruma #3, 17 July 1961; La Mesa, 27 Aug. 1961; Lancetilla, 2 June 1961, Spring 1962; 2♂♂, 4♀♀ (RNW). El Jaral, 13 Aug., 1♂ (RSM).

Satyridae

**Callitaera menander* (Drury).—Lancetilla (500′), 27 June 1961, 1♂ (RNW).
**Antirrhea miltiades* (Fabr.).—Lancetilla, Spring 1962, 1♂ (RNW). This species has been previously reported from Guatemala and Nicaragua (Seitz, 1923).
**Pierella luna luna* (Fabr.).—Lancetilla, 30 June 1961, 1♂ (RNW). This species has been previously recorded from most of the other Central American countries (Seitz, 1923).
**Taygetis andromeda* (Cr.).—Lancetilla, Spring 1962, 2♂♂ (RNW). El Jaral, 12, 13, 14 Aug., 16 Sept.; Lancetilla, 19 Aug.; 4♂♂, 1♀ (RSM). Previously, this satyr has been known from countries on both sides of Honduras (Seitz, 1923).
Taygetis nympha Btlr.—Lancetilla, 7 June 1961, 1♂, 1♀ (RNW).
**Euptychia hesione* (Sulz).—San Alejo, 19 Nov. 1961, 1♂ (RNW). El Jaral, 9 Aug., 2♂♂ (RSM).
Euptychia metaleuca (Boisd.).—El Jaral, 27, 28 Aug., 17 Sept., 2 Nov., 2♂♂, 3♀♀ (RSM).
Euptychia labe Btlr.—Lancetilla, 19 Aug., 1♀ (RSM).
Euptychia hermes (Fabr.).—La Lima, 6 Feb., 24 March; Lancetilla, 27 Jan.; 4♂♂, 1♀ (RNW). El Jaral, 6, 14 Aug.; Siguatepeque, 24 Aug.; Lancetilla, 19 Aug.; 4♂♂, 2♀♀ (RSM).
Euptychia libye (L.).—El Jaral, 9, 12, 13, 28 Aug., 16, 17 Sept.; 3 mi. S El Corpus, 29 Sept.; 6 mi. NE Namasigüe, 29 Sept.; 5♂♂, 4♀♀ (RSM). In Honduras the species previously has not been recorded from the mainland or the Pacific slope.
Euptychia similis Btlr.—Lancetilla, 17 Aug., 1♀ (RSM).
**Cyllopsis hedemanni* Feld.—El Jaral, 17 Sept., 1 specimen of undetermined sex

(RSM). This species has been previously recorded from Mexico, Guatemala, and Costa Rica (Seitz, 1923).

BRASSOLIDAE

Opsiphanes tamarinde Feld.—La Lima, 24 March 1961; Lancetilla, 23 June 1961; 2♀♀ (RNW).

Opsiphanes guiteria quirinus G. & S.—Cerro Santa Bárbara (3500′), 28 Nov., 1♂ (RSM).

Opsiphanes cassina fabricii (Boisd.).—San Alejo, 22 Aug. 1961; La Lima, 28 Jan.; 2♂♂, 2♀♀ (RNW). San Pedro Sula, 20 March 1963, 1♂ (RSM). The San Alejo individual was captured as it emerged from its pupa on a Royal Palm tree. Bates (1932) investigated the life history of this species at Tela.

**Caligo oileus scamander* (Boisd.).—Lancetilla, 28 June 1961, 1♂ (RNW). Lancetilla, 19 Aug., 1♂ (RSM). This species has been recorded by Seitz (1923) from "Costa Rica, Panama (?), Mexico (?), and Guatemala (?)."

Caligo memnon (Feld.).—La Lima, 13 Aug. 1961, 1♂ (RNW). El Jaral, 21 Aug., 2, 17 Sept., 14, 22 Nov., 3♂♂, 2♀♀ (RSM). These butterflies were seen in their typical crepuscular flight pattern in semi-open forest. In addition, they were noted in large numbers around ripened bananas; the larvae are known to cause considerable damage to bananas.

Caligo eurilochus sulanus Fruhs.—Lancetilla, 6 Feb., 1♀ (RNW).

NYMPHALIDAE

Morpho peleides montezuma Guén.—El Jaral, 28 Aug., 1♂ (RSM). Besides the recorded specimen, there were many additional sight records, which may have been of other species in this genus. Of particular interest are sightings of two individuals flying across the road in very arid localities. One was seen on 24 Sept. 1962 (RSM) near Comayagua in the Comayagua Valley, typified by scrubby growth with cacti; a few days later, south of Tegucigalpa in the Dept. of Francisco Morazán, another was recorded in a region of precipitous mountains with scrubby pines.

Actinote anteas (Doubl. & Hew.).—El Jaral, 17 Sept.; Cerro Santa Bárbara (4500′), 28 Oct.; 2♀♀ (RSM).

**Actinote leucomelas* (Bates).—Cerro Santa Bárbara (4000′), 7 Dec., 1♂, 1♀ (RSM).

Dryadula phaetusa (L.).—Lancetilla, Spring 1962, 1♂ (RNW).

**Agraulis vanillae incarnata* (Riley).—La Lima, 3 Sept. 1961, 1♂ (RNW). El Jaral, 12 Aug., 1♂ (RSM).

**Dione juno huascama* (Reak.).—El Jaral, 14 Aug., 1♂ (RSM).

**Dione moneta poeyii* (Btlr.).—El Jaral, 18 Sept., 1♂ (RSM).

Dryas iulia iulia (Fabr.).—Calán, 17, 18, 25 May; La Lima, 27 Aug. 1961, 7, 15 May; Progreso, 21 May 1961; Lancetilla, 11 June 1961, 25 Jan., 21 April, Spring 1962; 12♂♂, 4♀♀ (RNW). El Jaral, 6, 11, 12, 13, 26 Aug.; Potrerillos, 11 Aug.; Dept. of Cortés, 10 Aug.; 5♂♂, 2♀♀ (RSM). This butterfly was one of the most common species in open areas.

**Heliconius (Semelia) aliphera gracilis* (Stich.).—El Jaral, 13 Aug., 23 Sept., 2♂♂, 1♀ (RSM).

Heliconius (Eueides) cleobaea zorcaon (Reak.).—El Jaral, 8, 12 Aug., 2♂♂, 1♀ (RSM).

Heliconius (Heliconius) ismenius telchinia Doubl.—San Alejo, 21 April; Lancetilla, 10 June 1961, Spring 1962; 3♂♂ (RNW). El Jaral, 17 Aug., 1♀ (RSM).

Heliconius (Heliconius) anderida zuleika Hew.—3 mi. S El Corpus, 29 Sept., 1♂ (RSM). This specimen was taken in monsoon forest.

**Heliconius (Heliconius) cydno galanthus* Bates.—Lancetilla, 27 June 1961, Spring 1962, 2♂♂ (RNW).

**Heliconius* (*Heliconius*) *doris transiens* Stgr.—Lancetilla, 20 June 1961, 1♀ (RNW).

Heliconius (*Heliconius*) *sapho leuce* Doubl.—Lancetilla, 26 May, 11 June 1961, Spring 1962, 3♂♂ (RNW).

**Heliconius* (*Heliconius*) *sara veraepacis* Bates.—El Jaral, 17 Sept. 1962, 1♂ (RSM). Seitz (1923) recorded this species from Guatemala and Panama.

Heliconius (*Heliconius*) *petiveranus* Doubl.—Calán, 25 May; Guaruma #3, 17 July 1961; La Lima, 13 Feb.; San Alejo, 19 Nov. 1961, 21 April; Lancetilla, 17, 23, 25 June 1961, 10 May, Spring 1962; 12♂♂, 1♀ (RNW). El Jaral, 6, 8, 9, 12 Aug., 4 Sept., 5♂♂ (RSM). This species usually was seen along forest edge or in semi-open areas.

Heliconius (*Heliconius*) *charitonius vazquezae* Com. & Br.—Calán, 17 May; La Mesa, 27 Aug. 1961; Lancetilla, Spring 1962; 3♂♂ (RNW). El Jaral, 8, 9, 12, 13 Aug., 4♂♂ (RSM). This species was frequently collected in open areas.

Heliconius (*Heliconius*) *hortense* Guér.—Cerro San Juancito (6000′), 18 Nov., 1♂ (RSM).

**Euptoieta hegesia hoffmanni* Com.—La Mesa, 27 Aug. 1961; La Lima, 13 Aug. 1961, 11 May; San Alejo, 31 May 1961; Lancetilla, 26 June 1961; 4♂♂, 2♀♀ (RNW). El Jaral, 8, 9, 25 Aug.; Potrerillos, 10, 29 Aug.; 6♂♂ (RSM). These are, surprisingly, the first specimens of this common insect recorded from Honduras.

Chlosyne janais (Drury).—Lancetilla, 6 July 1961, 1♂, 1♀ (RNW). El Jaral, 9, 13, 14, 27 Aug., 5♂♂, 2♀♀ (RSM). All specimens are of the form *irrubescens* Hall.

**Chlosyne hippodrome* (Geyer).—3 mi. S El Corpus, 29 Sept.; 6 mi. NE Namasigüe, 29 Sept.; 2♂♂ (RSM). Seitz (1923) recorded this species only from Mexico, Panama, and Colombia.

Chlosyne lacinia lacinia (Geyer).—El Jaral, 12, 17, 23, 27 Aug.; Potrerillos, 10, 29 Aug.; Dept. of Cortés, 10 Aug.; El Sauce, 12 Sept.; 13♂♂ (RSM). There are a variety of forms represented among these specimens.

Chlosyne melanarge (Bates).—Cofradía, 3 Sept. 1961, 1♂, 1♀ (RNW).

Chlosyne erodyle (Bates).—El Sauce, 12 Sept., 1♂ (RSM).

Chlosyne gaudealis (Bates).—Lancetilla, 17 June 1961, Spring 1962, 3♂♂, 2♀♀ (RNW). Lancetilla, 17 Aug., 1♀ (RSM). Several of these specimens are of the form *laeta* Röber.

Thessalia theona (Ménét.).—El Jaral, 6, 12, 13, 14, 29 Aug., 1♂, 4♀♀ (RSM).

**Microtia elva* Bates.—Palmerola, 28 Sept., 1♂ 1♀ (RSM). These specimens were captured as they flew low in an open, though shaded, dry area.

Phyciodes (*Eresia*) *frisia tulcis* (Bates).—La Lima (greenhouse), 20 Feb., 1♂ (RNW). El Jaral, 6, 10, 25, 27 Aug., 3♂♂, 1♀ (RSM). Genitalic dissections indicate that these specimens are typical of the subgenus *Eresia* and are definitely *frisia*.

Phyciodes (*Eresia*) *claudina guatemalena* (Bates).—El Jaral, 9, 12, 13, 14, 26 Aug., 9 Sept., 8♂♂, 2♀♀ (RSM).

Phyciodes (*Eresia*) *clio* (L.).—El Jaral, 12, 14, 26, 27 Aug., 4 Sept., 6♂♂, 1♀ (RSM).

Phyciodes (*Eresia*) *phillyra phillyra* (Hew.).—El Jaral, 6, 8, 13 Aug., 4, 17, 23 Sept., 4♂♂, 3♀♀ (RSM). According to Hall (1928–1930), no specimens have been previously captured in August or September.

**Phyciodes* (*Tritanassa*) *atronia* (Bates).—El Jaral, 12 Aug., 4 Sept., 2♂♂ (RSM). This species is found in virtually every other Central American country (Hall, 1928–1930).

Phyciodes (*Tritanassa*) *drusilla* (Feld.).—El Jaral, 12, 14, 25, 28 Aug., 4 Sept., 4♂♂, 1♀ (RSM).

**Phyciodes* (*Tritanassa*) *subota* G. & S.—El Jaral, 6, 9, 21, 25, 27 Aug., 5♂♂,

1♀ (RSM). These apparently represent a new Honduran record, since Hall (1928–1930) did not mention a Honduran specimen that could definitely be assigned to *P. subota.*

**Phyciodes (Tritanassa) eranites* (Hew.).—El Jaral, 17 Sept., 1♂ (RSM).

**Phyciodes (Tritanassa) griseobasalis* Röber.—El Jaral, 14 Aug., 1♂ (RSM).

**Vanessa virginiensis* (Drury).—El Jaral, 13 Aug., 1♀ (RSM).

Junonia evarete evarete (Cr.).—Calán, 14 July 1961; La Mesa, 26 July 1961; 1♂, 1♀ (RNW). El Jaral, 14 Aug.; Potrerillos, 11 Aug.; 2♂♂ (RSM).

**Anartia jatrophae luteipicta* Fruhs.—La Lima, 11 July 1961, 2 April; Lancetilla, 2, 30 June 1961; 3♂♂, 2♀♀ (RNW). El Jaral, 28 Aug., 5 Sept.; Potrerillos, 10, 11 Aug.; Dept. of Cortés, 10 Aug.; 7♂♂, 1♀ (RSM). These individuals were found in dry, open grassy areas.

Metamorpha stelenes biplagiata (Fruhs.).—Calán, 9, 14 July 1961; La Lima, 19 July 1961; 5♂♂ (RNW). El Jaral, 10, 12, 13 Aug., 3♀♀ (RSM). This species frequently was seen in the forest or along its edge.

Metamorpha epaphus (Latr.).—Progreso, 20 Jan.; Lancetilla, Spring 1962; 2♂♂, 1♀ (RNW). El Jaral, 9, 13, 25 Aug., 5 Sept., 26 Oct.; 3♂♂, 2♀♀ (RSM). These individuals were found along or near the forest edge.

**Metamorpha superba* (Bates).—El Jaral, 1 Nov., 1♂ (RSM).

Hypanartia lethe (Fabr.).—El Jaral, 14, 27, 28 Aug., 17 Sept., 3♂♂, 1♀ (RSM).

**Hypanartia dione* (Latr.).—Cerro San Juancito (6750′), 18 Nov., 1♀ (RSM). This species is recorded from Guatemala and South America (Seitz, 1923).

Hypanartia venusta Fruhs.—Lancetilla, 5 June 1961, 25, 27 Jan., Spring 1962, 5♂♂, 1♀ (RNW). El Jaral, 6, 11 Aug., 4♂♂, 1♀ (RSM).

**Biblis hyperia aganisa* Boisd.—Calán, 29 Oct. 1961; Lancetilla, 19 May; 2♂♂ (RNW). El Jaral, 5 Nov., 1♂ (RSM).

Pyrrhogyra hypensor G. & S.—Calán, 18 May, 1♂ (RNW).

**Pyrrhogyra otolais neis* Feld.—Lancetilla, 16 June 1961, 1 specimen of undetermined sex (RNW). El Jaral, 5 Sept., 1♂ (RSM).

Pseudonica flavilla canthara (Doubl.).—El Jaral, 14, 26 Aug., 3♂♂ (RSM).

Catonephele nyctimus (Westw.).—El Jaral, 9, 14 Aug., 5 Sept., 2♂♂, 2♀♀ (RSM).

Catonephele numilia esite (R. Feld.).—El Jaral, 11, 12 Sept., 2♂♂ (RSM).

**Nessaea aglaura* (Westw. & Hew.).—El Jaral, 23 Sept., 1♀ (RSM). Seitz (1923) mentioned records only from Mexico and Guatemala.

**Catagramma pacifica* Bates.—El Jaral, 13 Aug., 1♂ (RSM).

Catagramma lyca Doubl. & Hew.—El Jaral, 10 Sept., 1♂ (RSM).

Catagramma titania Sal.—El Jaral, 8, 15 Aug., 2♂♂ (RSM).

**Catagramma pitheas* (Latr.).—El Corpus, 10 Feb. 1963, 1♀ (RSM). This species was conspicuous and numerous on this date in the monsoon forest, although Monroe had not seen them on an earlier visit in October, 1962. Those individuals observed in February were in rather dense, though dry, vegetation and were flying 2–3 feet above the ground. Godman and Salvin (1879–1901) recorded this species from Nicaragua southward.

Diaethria anna (Guér.).—Progreso, 21 May 1961; Lancetilla, Spring 1962; 4♂♂ (RNW). El Jaral, 8, 14, 27 Aug., 10 Sept., 3♂♂, 1♀ (RSM).

Diaethria astala (Guér.).—Progreso, 21 May 1961; Lancetilla, Spring 1962; 3♂♂ (RNW). El Jaral, 13, 14, 25 Aug., 4, 9 Sept., 4♂♂, 2♀♀ (RSM). At El Jaral, this species and *D. anna* were captured flying in an open grassy area along a small stream adjacent to forest.

Dynamine theseus Feld.—Calán, 18 May; Lancetilla, Spring 1962; 2♂♂ (RNW). Potrerillos, 11 Aug., 1♂ (RSM).

Dynamine mylitta (Cr.).—El Jaral, 12, 14 Aug., 4, 16 Sept.; Potrerillos, 29 Aug.; 7♂♂ (RSM). These individuals were captured as they flew near the ground in semi-open, moist areas.

**Dynamine glauce* (Bates).—Calán, 17 May, 1♀ (RNW).

Hamadryas februa gudula (Fruhs.).—El Jaral, 4 Sept., 1♂ (RSM). All individuals representing this genus were collected in semi-open areas as they flew from tree to tree with an erratic flight, clicking their wings in characteristic manner.

Hamadryas feronia farinulenta (Fruhs.).—El Jaral, 16 Sept., 2♂♂, 1♀ (RSM).

**Hamadryas ferox* (Stgr.).—Calán, 14 July 1961, 1♀ (RNW). This specimen appears to be the form *diasia* (Fruhs.).

**Hamadryas fornax* (Hüb.).—El Jaral, 25, 27 Aug., 2♂♂ (RSM).

**Hamadryas iphthime* (Bates).—El Jaral, 16 Sept., 1♂ (RSM).

Hamadryas laodamia laodamia (Cr.).—El Jaral, 10 Aug., 9 Sept., 2♂♂ (RSM).

Hamadryas amphinome mexicana Luc.—El Jaral, 9, 13 Aug., 2♂♂ (RSM).

Marpesia chiron (Fabr.).—Calán, 17, 25 May; Lancetilla, 30 June 1961, 17 May; 5♂♂, 1♀ (RNW). El Jaral, 21 Aug.; Potrerillos, 29 Aug.; 3♂♂ (RSM).

**Marpesia merops* (Blanch.).—Lancetilla (500′), 27 June 1961, 1♂, 1♀ (RNW). These specimens were taken in the denser rain forest at Lancetilla. They represent a northern extension of the range of this species. Seitz (1923) recorded the species from Costa Rica to South America.

Marpesia berania (Hew.).—El Jaral, 12 Aug., 22 Sept., 3♂♂ (RSM).

**Limenitis (Adelpha) cytherea marcia* (Fruhs.).—San Alejo, 19 Nov. 1961, 1♂ (RNW).

**Limenitis (Adelpha) iphicla* (L.).—Guaruma #2, 4 Sept. 1961, 1♂ (RNW). El Jaral, 12 Aug., 23 Sept., 2♀♀ (RSM).

**Limenitis (Adelpha) lerna* (Hew.).—Lancetilla, Spring 1962, 1♂ (RNW). Seitz (1923) recorded this species from Nicaragua to Colombia.

**Limenitis (Adelpha) paraeca* (Bates).—El Jaral, 12 Aug., 5 Nov. 1962, 2♂♂ (RSM). This species was recorded by Seitz (1923) from Guatemala and Costa Rica.

Chlorippe pavon (Latr.).—El Jaral, 1 Nov., 1♂ (RSM).

Chlorippe laure (Drury).—Calán, 25 May, 1♂ (RNW). Amapa, 13 Sept.; Potrerillos, 29 Aug.; 2♂♂ (RSM). This species was taken along roadsides adjacent to forest.

**Historis odius* (Fabr.).—Lancetilla, Spring 1962, 1♂ (RNW). El Jaral, 25 Aug., 2 Dec., 2♂♂ (RSM). The specimen taken on 2 December was shot from the upper branches of a tall rain forest tree.

**Historis acheronta* (Fabr.).—La Mesa, 26 July 1961, 1♀ (RNW). This individual was taken from what appeared to be a migrating group which was flying at about 10 feet above an open grassy field.

Smyrna blomfildia datis Fruhs.—El Jaral, 21 Aug., 1♂ (RSM).

Gynaecia dirce (L.).—La Lima, 12 Feb., 1♂, 1♀ (RNW). Cerro Santa Bárbara (4500′), 28 Oct., 1♂ (RSM). The specimens from La Lima were reared from larvae taken on *Cecropia hondurensis* Standley. The other individual was captured while it was flying along a logging road in low montane rain forest.

Anaea (Memphis) oenomais (Boisd.).—El Jaral, 27 Aug., 1♂ (RSM).

Anaea (Memphis) pithyusa (Feld.).—Potrerillos, 29 Aug., 1♂ (RSM). This individual has semi-acute forewings.

Anaea (Memphis) eurypyle confusa Hall.—El Jaral, 22 Sept., 2♂♂ (RSM). The wings of these two specimens are not acute.

Libytheidae

Libytheana carinenta mexicana Mich.—Calán, 17 May; Cofradía, 30 Sept. 1961; 1♂, 1♀ (RNW).

Lycaenidae

Nearly all the members of this family were collected in semi-open, forested regions (primarily along forest edge) or in open fields.

**Callophrys amyntor distractus* Clen.—El Jaral, 21 Aug., 1♂ (RSM).

**Callophrys herodotus* (Fabr.).—El Jaral, 17 Sept., 1♀ (RSM).

**Calycopis trebula* (Hew.).—San Alejo, 17 April 1963, 1♀ (RSM). Because of the poor condition of this specimen, the identification is tentative. This individual was taken in second-growth tropical forest.

Calycopis beon (Cr.).—El Jaral, 9, 12, 29 Aug., 17 Sept., 5 Nov., 3♂♂, 3♀♀ (RSM).

**Strymon yojoa* (Reak.).—El Jaral, 5 Nov.; Palmerola, 28 Sept.; 1♂, 1♀ (RSM).

**Thecla marsyas damo* (Druce).—El Jaral, 12 Aug., 17 Sept., 3♂♂ (RSM).

**Thecla battus aufidena* Hew.—Lancetilla, 2, 5 June 1961, 1♂, 1♀ (RNW). El Jaral, 28 Aug., 17 Sept., 2♂♂ (RSM).

**Thecla linus togarna* Hew.—El Jaral, 6, 14 Aug.; Lancetilla, 19 Aug.; 4♂♂ (RSM).

**Thecla meton* (Cr.).—El Jaral, 9, 14, 21, 27 Aug., 17, 23 Sept., 9♂♂, 3♀♀ (RSM).

Thecla syncellus syncellus (Cr.).—El Jaral, 20 Sept., 5 Nov., 1♂, 1♀ (RSM).

*"*Thecla*" *talayra* Hew.—Lancetilla, 18 June 1961, 1♂ (RNW).

*"*Thecla*" *polibetes* (Cr.).—El Jaral, 12 Aug., 23 Sept., 2♀♀ (RSM).

*"*Thecla*" *cambes* G. & S.—El Jaral, 13 Aug., 1♂ (RSM).

*"*Thecla*" *scopas* G. & S.—El Jaral, 23 Sept., 1♀ (RSM).

*"*Thecla*" *kalikamaha* Clen.—El Jaral, 13 Aug., 1♀ (RSM).

"*Thecla*" *sito* (Boisd.).—El Jaral, 17 Sept., 2♂♂ (RSM). These specimens are the first recorded from the Honduran mainland, the species having been previously recorded from Ruatan (Godman and Salvin, 1879–1901).

Hemiargus ceraunus zachaeina (Btlr. & Druce).—Tela, 18 Aug.; Palmerola, 28 Sept.; 3♂♂, 2♀♀ (RSM). This species was also seen in numbers on Utila, one of the Bay Islands, in May, 1963 (RSM). The specimens from Palmerola were taken at the same locale as *Microtia elva*, a spot very unlike the beach at Tela.

Everes comyntas comyntas (Godt.).—El Jaral, 6, 26 Aug., 4, 23 Sept.; Tela, 18 Aug.; Lancetilla, 19 Aug.; 6♂♂ (RSM).

RIODINIDAE

**Euselasia chrysippe* (Bates).—Lancetilla, 17 Aug., 1♀ (RSM).

**Euselasia eubule* (R. Feld.).—El Jaral, 5 Nov., 2♂♂ (RSM).

**Leucochimona vestalis vestalis* (Bates).—El Jaral, 5 Sept.; Lancetilla, 19 Aug.; 1♂, 1♀ (RSM).

Mesosemia tetrica Stich.—El Jaral, 12, 26 Aug., 2♂♂ (RSM). This species was seen in moist, weedy, shaded areas along forest edge.

**Eurybia halimede* (Hüb.).—El Jaral, 17 Sept., 1♀ (RSM).

**Rhetus arcius thia* (Mor.).—El Jaral, 14 Aug., 1♂ (RSM). This specimen was taken in a forest clearing where a garden was planted.

**Calephelis velutina* (G. & S.).—El Jaral, 12, 13 Aug., 2♂♂ (RSM).

**Calephelis argyrodines* Bates.—El Jaral, 9, 12 Aug.; Siguatepeque, 24 Aug.; 3♂♂ (RSM).

Calephelis spp.—El Jaral, 9, 10, 12, 14, 17 Aug., 6♂♂, 1♀ (RSM). There are apparently two different species in this group of unidentified *Calephelis*. The six males have a ventral pattern that is similar to that of *C. argyrodines*, but they are twice the size of the latter. The single female is quite different from any other specimen we have.

**Charmona gynaea zama* (Bates).—El Jaral, 14 Aug., 23 Sept., 2♂♂ (RSM).

**Lasaia narses* Stdgr.—El Jaral, 9, 13, 14 Aug., 5 Nov., 3♂♂, 1♀ (RSM).

**Symmachia accusatrix* Westw.—El Jaral, 17 Sept., 1♂ (RSM).

**Charis myrtea* (G. & S.).—El Jaral, 13 Aug., 2♂♂, 1♀ (RSM).

**Anteros formosa* (Cr.).—El Jaral, 13 Aug., 2♂♂ (RSM).

Emesis lupina G. & S.—El Jaral, 9, 25 Aug., 4, 22 Sept., 3♂♂, 1♀ (RSM).

Emesis tenedia Feld.—El Jaral, 21 Aug., 23 Sept., 2♂♂ (RSM).

Emesis mandana mandana (Cr.).—El Jaral, 12, 27 Aug., 17, 23 Sept., 5♂♂ (RSM).

**Emesis ocypore* (Hüb. & Geyer).—El Jaral, 13 Aug., 1♀ (RSM).

Emesis sp.—El Jaral, 14 Sept., 1♂? (RSM). This individual is much darker than any other *Emesis* in our collections.
Theope virgilius Fabr.—El Jaral, 13, 14 Aug., 2♂♂, 1♀ (RSM). Identification of these specimens is tentative.
**Lemonias cilissa* Hew.—El Jaral, 9, 14 Aug., 2♂♂ (RSM).
**Peplia lamis molpe* (Hüb.).—El Jaral, 12 Aug., 23 Sept., 1♂, 1♀ (RSM).
**Peplia ascolia* (Hew.).—El Jaral, 9 Aug., 1♂ (RSM).
**Calociasma lilina* (Btlr.).—El Jaral, 12 Aug., 1♀ (RSM).

Acknowledgments

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THE LIFE HISTORY OF *PERIPHOBA HIRCIA* (SATURNIIDAE) WITH A NOTE ON DISTRIBUTION AND LARVAL VARIATION

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This paper is one of a series dealing with the rearing of Neotropical Saturniidae from eggs imported into England. *Periphoba hircia* Cramer was found to be one of the easier species to rear and was one of the few in which it was possible to carry stock for several generations. Larvae originating from Trinidad were found to differ from Panamanian examples.

P. hircia is not included in the catalogue of the Trinidad Lepidoptera by Kaye and Lamont (1923). It is, however, represented in the collection of the New York Zoological Society by specimens from the Arima valley (Blest, *in litt.*) and has been recorded as readily available from there by Blest (1960a). The eggs sent to me were laid by a female caught in the Arima valley, by Dr. T. S. Collett. Those from Panama were laid by females caught on Barro Colorado Island by Dr. A. D. Blest.

REARING TECHNIQUE

All stages were kept at 20–25° C, with occasional fluctuations of ± 5° C. The humidity was uncontrolled. The eggs and first instar larvae were kept in small glass-topped metal tins; second and third instar larvae in plastic boxes; larvae from the fourth instar onwards in large wooden and muslin cages, 18 inches square, two feet high. Pupation took place in these cages and so did adult pairing. All stages were subject to natural British daylight conditions, with irregular extra artificial light from time to time in the evenings whilst the stocks were being attended to. Under these conditions there was no diapause and the total period of the life history was about five months.

OBSERVATIONS

Egg.—Very slightly ovoid, measuring 2.5 mm × 2.3 mm × 2.5 mm. Color white with a small black micropyle. Laid in regular batches, weakly attached with a clear cement. Pale green when just laid, turning white in a matter of seconds.

In captivity only about 200 eggs or less were obtained. A dissected virgin contained approximately 400 eggs.

A very curious phenomenon was the partial collapse of the eggs a few days before hatching. The top of the egg became depressed inwards to form a shallow depression around the micropyle. At first it was thought that these eggs were going to prove infertile, but subsequently

it was noticed that genuine infertile eggs collapsed not only more quickly, but from the sides. There was no color change prior to hatching, nor was the developing larva visible through the rather thick shell. Hatching occurred three weeks after laying.

Larvae.—The smaller larvae are gregarious and processionary, feeding and resting in groups. By the fourth instar they have started to disperse, feeding singly at night, and remaining in their feeding position during the day. The larvae have six instars, and show a fair amount of scatter in the time taken to pass through the last two. There was no significant difference in the development times of those from Panama or Trinidad. The instar development times, in days, were as follows: 1st—9; 2nd—7; 3rd—7; 4th—9; 5th—7–17; 6th—13–28. Mean total 53.

The first and second instar Panamanian larvae are a fairly uniform reddish-brown, with black spines. Those from Trinidad are chocolate-brown. In the third instar a green lateral line develops; in the fourth the green extends over the dorsal surface and the fifth and sixth instars are virtually similar.

Full-grown larvae (Panama) (Fig. 1) 7–10 cm long (females larger than males). Dorsal surface a pale, rather whitish, blue-green, a little less whitish laterally. Spiracles orange. Ventrally the whole surface a uniform pale green. On abdominal segments a pronounced lateral ridge which gradually becomes light purplish toward the head end. Prolegs translucent green, claspers on inner side brown; fringed with white hairs. Anal segment and claspers outlined in pink. Chalazae short, with dense spines, especially on dorsal surface. Segments 1–3 with four chalazae on each side; on segments 4–5, lateral chalazae modified; from segment 6 onwards rather smaller spines, no sublateral. Along the lateral line the chalazae short, with four short spines and two long white ones directed along the lateral line. On segment 11 a densely spined central dorsal chalaza. Penultimate segment with a small central dorsal chalaza and on either side two long (1.5–2.0 cm) whitish chalazae with short spines. Spines and chalazae green, similar to body.

Sting.—Of all the Hemileucinae larvae whose sting the author has experienced, *P. hircia* was by far the most painful. There also appears to be a difference between the long lateral spines and the others. The ordinary spines produced an effect similar to that of a nettle (*Urtica dioica*), but far more persistent, the skin still being tender after five hours. The effect had worn off by the following morning. From the long lateral spine there was a burning sensation similar to that of a honey bee (*Apis mellifera* L.) sting. There was a slight reddening and swelling and the skin was hot and remained swollen and tender for several days. A red mark (similar to a blood blister) was evident after four days and this persisted for about three weeks. It is worth mentioning that the effect from no other Hemileucid larva has lasted more than half-an-hour.

Larval differences: Trinidad vs. Panama.—While there are no struc-

tural differences, the larvae from Trinidad differed in color and to some extent in behavior, from the Panamanian. The earlier instar difference has already been mentioned above. In the final instar the shade of green is different. The dorsal surface on Trinidad individuals is dark green, the chalazae and spines similar, becoming even darker laterally. The lateral ridge is whitish with the spines greenish-white and black-tipped. Ventrally Trinidad larvae are greenish blue, rather darker than the Panamanian examples and with a sprinkling of small blackish dots. The claspers are similar, feet outlined brown. The head is rather shiny green. Dorsally, the intersegmental membrane between segments 3–4; 4–5; 5–6; and 6–7 is crimson. This color is not visible when the larva is normally at rest, but when it is disturbed the larva assumes a curved position like an interrogation mark [?], the head being tucked into the forelegs. The crimson then comes prominently into view. The long chalazae on the penultimate segment are greenish-white with blackish spines. The anal segment is entirely pinkish-brown.

Although it was not possible to carry out detailed and controlled experiments on behavior, the larvae from Trinidad and from Panama were reared side by side and it was possible to make a few general observations on the behavioral differences.

In the earlier instars (the third especially) the Trinidad larvae exhibited a communal reaction on being disturbed as, for instance, jarring the plastic box they were in. This reaction consisted in throwing the head and thoracic segments up into the air two or three times. This reaction could not be initiated in the Panama larvae.

In the middle instars the Trinidad larvae showed a marked tendency to drop off their food and wriggle violently on the floor on being disturbed. This usually happened when they were being given fresh food. Up to about 50 per cent would sometimes do this. With the Panama larvae a few would do this, certainly not more than 10 per cent, and it was considered that both lots were being given about an equal amount of disturbance and the cages contained approximately equal numbers of larvae.

Finally in the final instar there was the assumption of the [?] position (Fig. 1), although to elucidate this, rather rough treatment (firm prodding; picking up with forceps) needed to be applied. This produced the crimson flash in the Trinidad larvae and there was the firm impression—which cannot, however, be supported by definite numerical data—that this reaction was more likely to be assumed by the Trinidad specimens.

It is interesting to speculate upon these differences. Poisonous spines do not constitute an absolute defence. It has been reported (Blest,

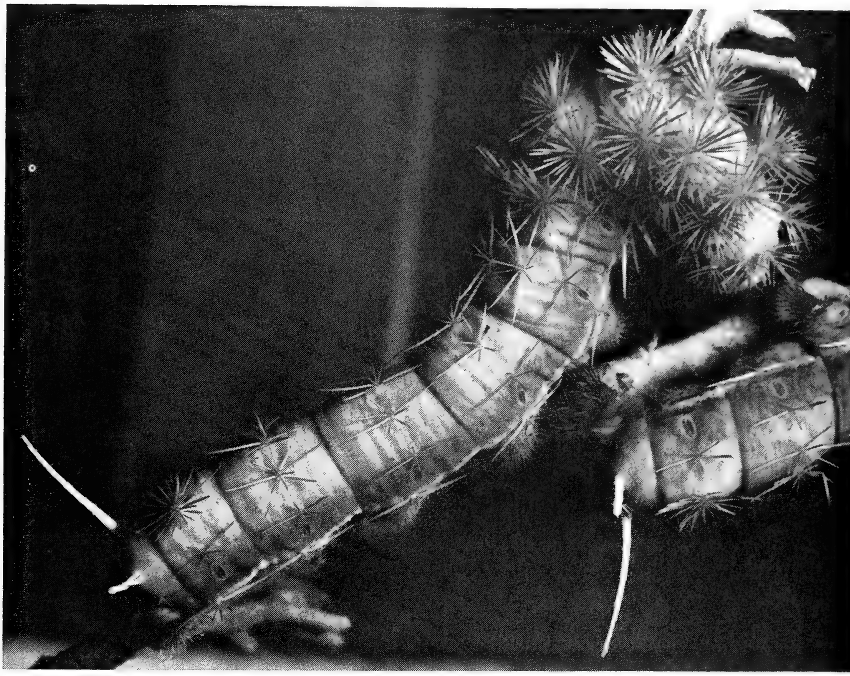

Fig. 1. Full-grown larva of *Periphoba hircia* Cramer. This larva shows the "?" position assumed when it is disturbed.

personal communication) that a Coatimundi (*Nasua* sp.) can roll the spines off *Automeris* spp. on stony ground and then eat the larvae. Only field observations in Trinidad and Panama can elucidate the problem associated with the crimson flash in *P. hircia*.

There is no recent revision of *Periphoba* and the Panamanian examples are true *hircia* and not the form *arcaei* reported by Draudt (1930) as corresponding with some specimens from Panama. The present author could not on gross differences, separate the adults from the two localities, but it is possible they may prove to be different species. On the other hand *Automeris memusae* Walker has different larvae from the southern and northern limits of its range according to studies by the present author. Due to lack of material no attempt could be made at cross-pairing the adults from the two localities.

Foodplants.—The larvae proved to be fairly polyphagous on temperate region deciduous trees, and on one evergreen tree. The newly-hatched larvae were given a wide choice. The majority of the larger larvae, however, were mainly fed on beech (*Fagus sylvatica*) or evergreen oak (*Quercus ilex*) due to their availability. The F_1 generation was reared

almost entirely on evergreen oak and in the final instar finished their development on hawthorn (*Crataegus oxyacantha*). The specimens of this generation were rather small compared to those of the first. The following leaves were readily eaten: various plums and cherries (*Prunus* spp.); black locust (*Robinia pseudoacacia*); beech (*Fagus sylvatica*); oaks (*Quercus* spp.); apple (*Malus* sp.); hawthorn (*Crataegus oxyacantha*); hornbeam (*Carpinus betulus*). Black poplar (*Populus nigra*) and privet (*Ligustrum ovalifolium*) were refused.

Pupation.—When the larvae are full grown the green color is gradually replaced by a pink shade, during a period of about 48 hours. This commences as a broad dorsal stripe and gradually diffuses over the rest of the body. The spines also fade and become yellowish. After wandering about for a day the larvae settled down to make a cocoon. They were supplied, in the rearing cage, with a few inches of moist peat on top of which was a thick layer of sphagnum moss. The majority of the cocoons were formed under the moss, the whole of the outside of the cocoon being firmly covered with the peat. The larvae pupated fairly uniformly over the floor area of the cage. This was in marked contrast to the choice of so many species which prefer the corners and angles and also to the very fussy larvae of *Dirphia curitiba* Draudt, which could not be induced to pupate in the cages and for which special provision had to be made (Gardiner, 1963).

The cocoon of *P. hircia* is a double structure. There is a thin, rather clear, papery inner chamber. The outer chamber is loosely spun and on its outer surface is firmly adherent to its surroundings, in this case particles of peat and moss. The inner chamber is suspended within the outer by a number of stalks, there being about one-eighth of an inch gap between the two.

The majority of the pupae were used for physiological experiments. The duration of the few retained was 2½–3 months.

Adults.—The freshly emerged adult gives off a pervading and persistent odor of rotten onions. Most of this odor appears to originate from the copious meconium. It is subtly different from, although similar to, and certainly more persistent than, the odor reported from *Eacles penelope* Cramer (Gardiner, 1967). Probably it serves the same purpose of protection during the vulnerable period while the wings are expanding and drying, although in the author's opinion it is not a foul odor as reported by Blest (1960b) for moths of the genus *Periphoba*. This, however, is a matter of opinion, and to predators with a well developed sense of smell it may indeed be a foul and even nauseating odor.

The adult moths were placed in a cage 18 inches square by 24 inches high. Several pairings were obtained, although not all the eggs laid were

Fig. 2. Adult *Periphoba hircia* Cramer. Female above, male below.

fertile. The moths were observed in copulâ about midnight and remained so until dusk the following evening. This lengthy period in copulâ is unusual among the Hemileucinae, most of those with which I am acquainted separate within an hour, or at least by dawn. Fig. 2 shows the adult moth.

An unusual habit of the unmated females was their habit of curling the abdomen and laying infertile eggs between their legs in a jumbled clump. The females would 'call' for two or three nights before doing this. Mated females lived for about six days, males only four, and they rapidly battered their wings in the cages. Adults kept at from –5° to 10° C could be kept alive for three weeks.

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A UNIDIRECTIONAL MASS MOVEMENT BY *Satyrium saepium* (LYCAENIDAE)

On 12 July, 1967, near the site of the ghost town of Nortonville in Contra Costa County, California, a large number of *Satyrium saepium* (Bdv.) were observed in a rather continuous downslope flight. The flight was noted only along the steeply inclined bottom of a small dry ravine where it passed northwesterly through grazed oak woodland. A broken canopy of live oak and arborescent toyon (*Heteromeles*) partly shaded the dry oat-forb understory. The insects were observed from about 12:30 to 1:00 PM. P.D.T., as they passed in an erratic stream perhaps no more than three or four feet wide and about three feet above the ground. Although no count was taken, it is estimated that the rate of passage varied from about five to fifteen individuals, averaging ten or twelve, per minute.

Generally the butterflies continued rapidly downward but occasionally an individual became diverted long enough to flutter briefly around the downstream base of a small rocky outcrop in the drainage bed. Only three or four individuals were seen to fly up the ravine. Probable larval food plant was common some hundred yards upstream in an extensive community of chamise—ceanothus chaparral. No water was available in the ravine or for some distance below its mouth. Some moisture was present in an adjacent ravine, where, however, only a few individuals of *S. saepium* were seen behaving in a manner not remarkable. Other examples of the species were encountered at more normal density elsewhere in the vicinity.

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ON THE STATUS OF *HELIOPETES SUBLINEA* (HESPERIIDAE)

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For some time there seems to have been considerable confusion concerning the exact status of *Heliopetes sublinea* Schaus. This species was described in 1902 from a specimen from Mexico, and since that time it has either been omitted from publications or considered to be a synonym of *Heliopetes macaira* Reakirt. Draudt, in Seitz (1924) does not mention this name, nor did Hoffmann in his "Catalogo sistematico y zoogeografico de los Lepidopteros Mexicanos" (1941). Evans in American Hesperiidae, part III (1953), records this species in the synonymy of *macaira* as "? *sublinea* Schaus 1902: Mexico."

During June 1935, while collecting in the general vicinity of Victoria, Tamaulipas, Mexico, I collected two males of a species of *Heliopetes* unfamiliar to me, and the following year during July I caught another male at Tamazunchale, San Luis Potosi, Mexico. In 1940 I sent one of the specimens to E. L. Bell for determination. He stated that it corresponded very well with a female that they had at the American Museum of Natural History in their unidentified Hesperiidae. In February, 1941, Bell wrote that the specimen had been identified as *sublinea* Schaus. He stated that the genitalia of it and the type had been compared and were found to be the same. After receiving this information I considered the matter closed, but when Evans' works on the American Hesperiidae appeared, I was concerned to find his remark concerning his idea of the status of *sublinea.* Recently I examined the genitalia of one of the other specimens that I had collected in 1935, and found that it certainly differs considerably from *macaira*, and, in fact, from any of the known species of *Heliopetes* figured by Evans, thus confirming the validity of the name *sublinea.*

Recently I received a large number of Mexican Hesperiidae from Dr. T. Escalante, Mexico, D. F., and among the material was a male *sublinea* from "Sn. Francisco," Tamaulipas, Mexico, VIII-64. In specimens received from Stallings & Turner collected in Mexico there were found the following specimens of *sublinea*: 2 males, Monterrey, Nuevo Leon, V-28-41; 1 male, Victoria, Tamaulipas, VI-10-41; and 1 male, Mante, Tamaulipas, VI-9-41. From the information available it seems that *sublinea* is confined to the area from Monterrey to Tamazunchale in Mexico. Flying in the same general region with this species are the

[1] I would like to express my thanks to the National Science Foundation for research grant GB-4122 which is making this study of the Mexican Hesperiidae possible.

following members of the genus *Heliopetes*: *domicella* Erichson, *macaira* Reakirt, *laviana* Hewitson, and *arsalte* (L.). This includes all of the species of that genus recorded from mainland Mexico except *ericetorum* (Bdv.), which Hoffmann records from "Region noroeste hasta Guerrero," and *alana* Reakirt, which occurs over all of the southern part of Mexico.

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OBSERVATIONS ON ARKANSAS RHOPALOCERA AND A LIST OF SPECIES OCCURRING IN NORTHEASTERN ARKANSAS

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The only recent extensive butterfly collecting in Arkansas has been by H. Avery Freeman, Kilian Roever, Richard Heitzman, Leo J. Paulissen and myself. I was the first resident collector in northeastern Arkansas and the only person to have collected butterflies extensively there. This paper summarizes collecting records and observations of over six hundred field hours in northeastern Arkansas between 1961 and 1965.

Northeastern Arkansas is defined as those counties bisected by Crowley's Ridge (Clay, Greene, Craighead, Poinsett, Cross, St. Francis, Lee and Phillips) and those eastward (Mississippi and Crittenden). This area is not generally favorable for Rhopalocera, and transient collectors are not likely to collect there. The area is highly cultivated in cotton, soybeans and rice—crops that are frequently sprayed with insecticides. Collecting is best on the hillier uncultivated sections of Crowley's Ridge and in areas along the Mississippi, Saint Francis and L'Anguilie Rivers. Crowley's Ridge is the outstanding geographic feature of the region, elevations along the ridge are only 300 to 500 feet above sea level but the surrounding region is flat with elevations under 250 feet. Crowley's Ridge still contains forested areas (especially in the St. Francis State Forest) and most of the species native to the original dense hardwood forests of the region should remain there.

Rhopalocera of Northeastern Arkansas

Abundant to Common Species:

Amblyscirtes vialis (Edwards)
Atalopedes campestris (Boisduval)
Polites themistocles (Latreille)
Pholisora catullus (Fabricius)
Erynnis juvenalis (Fabricius)
Thorybes pylades (Scudder)
Battus philenor (Linnaeus)
Papilio glaucus Linnaeus
Graphium marcellus (Cramer)
Nathalis iole Boisduval
Colias eurytheme Boisduval
Calycopis cecrops (Fabricius)
Satyrium falacer (Godart)
Libytheana bachmanii (Kirtland)
Limenitis archippus (Cramer)
Junonia coenia (Hübner)
Phyciodes tharos (Drury)
Danaus plexippus (Linnaeus)

Uncommon to Scarce Species:

Panoquina ocola (Edwards)
Amblyscirtes aenus linda Freeman
Euphyes vestris (Boisduval)
Pompeius verna (Edwards)
Nastra lherminier (Latreille)
Erynnis persius (Scudder)
Staphylus mazans hayhurstii (Edwards)
Epargyreus clarus (Cramer)
Colias cesonia (Stoll)
Eurema nicippe (Cramer)
Chrysophanus titus mopsus (Hübner)
Celastrina argiolus (Linnaeus)
Asterocampa celtis (Boisd. & LeConte)
Vanessa cardui (Linnaeus)
Polygonia comma (Harris)
Agraulis vanillae (Linnaeus)
Euptychia gemma (Hubner)

Rare or Casual Species:

Calpodes ethlius (Stoll)
Hesperia meskei (Edwards)
Thorybes confusis Bell
Papilio cresphontes Cramer
Incisalia henrici (Grote & Robinson)
Lycaena phleas americana Harris
Asterocampa clyton (Boisd. & LeConte)
Phyciodes phaon (Edwards)
Atrytone delaware (Edwards)
Wallengrenia otho (Smith)
Hylephila phyleus (Drury)
Pyrgus communis (Grote)
Thorybes bathyllus (Smith)
Achalarus lyciades (Geyer)
Papilio polyxenes asterius Stoll
Papilio troilus Linnaeus
Pieris protodice Boisd. & LeConte
Pieris rapae (Linnaeus)
Eurema lisa Boisd. & LeConte
Strymon melinus Hubner
Everes comyntas (Godart)
Limenitis arthemis astyanax (Fabricius)
Vanessa atalanta (Linnaeus)
Polygonia interrogationis (Fabricius)
Euptoieta claudia (Cramer)
Euptychia cymela (Cramer)
Lerodea eufala (Edwards)
Amblyscirtes celia belli Freeman
Poanes zabulon (Boisd. & LeConte)
Lerema accius (Smith)
Erynnis brizo (Boisd. & LeConte)
Erynnis horatius (Scudder & Burgess)
Autochton cellus (Boisd. & LeConte)
Colias philodice Godart
Phoebis sennae eubule (Linnaeus)
Anthocaris midea Hubner
Satyrium edwardsii (Grote & Robinson)
Anaea andria Scudder
Vanessa virginiensis (Drury)
Nymphalis antiopa (Linnaeus)
Melitaea nycteis (Doubleday)
Euptychia hermes sosybius (Fabricius)
Polites coras (Cramer)
Erynnis zarucco (Lucas)
Battus polydamas (Linnaeus)
Mitoura gryneus (Hubner)
Lycaena thoe Guerin-Menevelle
Hemiargus isola (Reakirt)
Polygonia progne (Cramer)
Chlosyne gorgone carlotta (Reakirt)

Sight Record:

Phoebis philea (Johansson)

Northeastern Arkansas is not as bountiful in species as are the Ozarks of northwestern Arkansas. The Ozarks reach higher elevations (1000 to 2000 feet above sea level) and are cooler, receive more precipitation, and hence, harbor boreal species such as *Speyeria cybele* (Fabricius),

Euphydryas phaeton (Drury), and *Euchloe olympia* (Edwards)— species not found in northeastern Arkansas. Many southern species such as *Eurema mexicana* (Boisduval), *Phyciodes texana* (Edwards) and *Leptotes marina* (Reakirt) enter the Ozarks from the southwest via the "Mexican Flyway" and are not recorded in northeast Arkansas.

Some species are inexplicably absent from northeastern Arkansas although abundant in surrounding areas. *Cercyonis pegala* (Fabricius) is one of these, and its absence is unfortunate because the nominate race might otherwise converge with race *texana* (Edwards) and race *alope* (Fabricius) there. *Mitoura gryneus, Phyciodes phaon, Papilio cresphontes* and a few others are uncommon here although abundant elsewhere in the state. The only species in this region and not occurring elsewhere in Arkansas is *Lycaena thoe.*

For convenience, the species are treated in three groups: abundant to common, ten to fifteen or more individuals might be encountered in a day; uncommon to scarce, two or three to a dozen would be expected; rare or casual, species only infrequently encountered.

A total of 86 species are recorded from northeastern Arkansas, not quite two-thirds of the 135 known for the entire state.

Additional comments are in order for some of the species listed as rare or casual:

Calpodes ethlius—A single specimen (15-VIII-1964) captured at Bear Creek Lake in Lee County.

Incisalia henrici—recorded from two specimens (14-IV-1963) taken at the Six Point Gun Club lodge in Lee County.

Lycaena thoe—all records are from along the Mississippi River in Mississippi County, Osceola (5-IX-1963, 25-VI-1964 and 10-VII-1964), O'Donnell Bend (20-VI-1964) and Luxora (10-IX-1964).

Lycaena phleas americana—a single specimen was captured (2-VII-1963) at Crowley's Ridge State Park in Greene County.

Hemiargus isola—migrated into the area in September 1963 and was found many places in Mississippi, Greene and Craighead counties.

Polygonia progne—was present in numbers along the Mississippi River in Mississippi County during 1962 and was also taken in Lee and Phillips counties that year.

Phoebis philea—The sight record was a single specimen at Osceola, Mississippi County during late June, 1963.

The most interesting records regard *Battus polydamas* which may be establishing itself in the state. The only record for northeastern Arkansas is a "rubbed" male that I captured (10-VII-1965) along the L'Anguilie River near its intersection with U.S. 70 in St. Francis County, but there are additional observations for the northcentral part of the state. I collected a male *polydamas,* the first record for Arkansas, feeding on honeysuckle at the White River Ferry-site near Norfork in Baxter county (16-V-1964). Later in the same day a worn female *polydamas* was observed ovipositing on pipevine (*Aristolochia serpentaria* Linnaeus) which was growing on an open hilltop overlooking the Norfork Damsite. I collected several dozen ova and young larvae and transported them to Osceola for rearing. I had two potted pipevine plants at home, but the voracious appetites of the larvae was not taken into consideration as they decimated them in two days. It was essential for me to drive four hundred miles on the evening of May 19th in order to gather more food plant at the original site and many additional ova and larvae were gathered along with three large ice water jugs stuffed with pipevine leaves.

Experimentation led to the discovery that pipevine leaves could be frozen and later thawed to feed the larvae. Older larvae would eat the thawed leaves which were dry and brittle but cannibalism, perhaps enhanced by this diet, became a problem. Larvae were especially vulnerable to cannibalism when suspending prior to pupation and were isolated at this point.

It was apparent that the larvae represented both *Battus philenor* and *polydamas* although they were inseparable in their early stages. The first adults emerged in late June and were *philenor.* Many *philenor* emerged before the first *polydamas* (7-VII-1964). Thirty-two additional *polydamas* emerged through mid-July along with a total of 106 *philenor*—this was from an estimated 400 ova and larva that had been collected.

The following year, a single *polydamas* was seen in flight (30-V-1965) near the fish hatchery at Norfork. The hilltop pipevine area had been freshly mown to a level of a few inches and only a few young larvae were to be found. Five were reared and proved to be *philenor.*

Acknowledgments

Acknowledgment is given to Richard Heitzman, H. Avery Freeman, Leo J. Paulissen, Fred T. Thorne and Harry K. Clench who were helpful in many ways, especially in confirming determinations of Hesperiidae; and to my wife, Wilma, for her help in rearing the larvae of *Battus polydamas* and *Battus philenor.*

MINUTES OF THE THIRTEENTH ANNUAL MEETING OF THE PACIFIC SLOPE SECTION OF THE LEPIDOPTERISTS' SOCIETY

The thirteenth annual meeting of the Pacific Slope Section of the society was held at the Santa Barbara Natural History Museum in Santa Barbara, California, on June 11 and 12, 1966. Lloyd Martin, Los Angeles County Museum, called the morning session to order. In his opening remarks, Mr. Martin stated that the purpose of these meetings is to provide an opportunity for both professional and amateur lepidopterists to exchange views and information. Nelson W. Baker, Curator of Invertebrate Zoology at the museum, gave a short address of welcome in which he extended the good wishes of the museum staff to our members and guests.

John Lane of Los Angeles, California, was elected Secretary *pro tempore.*

The Presidential Address was read for President D. B. Stallings of Caldwell, Kansas, by Ronald Leuschner. In his address, Mr. Stallings said that in the past, lepidopterists have not applied an evolutionary basis to the proposal of new taxa and analysis of old ones; because of this, lepidopterology is behind other biological fields in applying new concepts and methods. Analysis and description of courtship behavior, life cycles, and genetically based differences are among the avenues of approach which might be used to improve our concepts of speciation. President Stallings pointed out as an example that introgressive hybridization seems to have been an important factor in the formation of new species of *Megathymus.*

Charles Hogue of the Los Angeles County Museum then introduced two short films. The first, "Desert Insects," was produced by Thomas Stanton, Los Angeles, with Frank Sala, Los Angeles, acting as consultant. The second film, "Butterfly Marvel," was by Tilden Roberts.

The business meeting included selection of a site for the 1967 Pacific Slope Meeting. E. J. Newcomer, Yakima, Washington, read an invitation to the group to hold that meeting at Corvallis, Oregon, using the facilities of Oregon State University. A letter from President Stallings was read in which the Pacific Slope Section was asked to include the National Meeting in its 1967 meeting plans.

The members present voted to accept the invitation from Oregon State University and to invite the National Meeting. Mr. Newcomer was elected program chairman for the 1967 meeting and Ernst Dornfeld, Oregon State University, was elected local arrangements chairman. It was agreed that Newcomer and Dornfeld would select the specific meeting date, keeping in mind that most members preferred a date in June.

The Secretary *pro tempore* was instructed to write letters of acceptance to Professor Dornfeld and Oregon State University; an invitation to President Stallings for the National Meeting to convene at Corvallis; and letters of appreciation to Charles Hogue, the program chairman, to Nelson W. Baker, the local arrangements chairman, to the Santa Barbara Natural History Museum for the use of its facilities and our delicious luncheon, to Mr. Levi Phillips for donating printed programs (as he has done for many years), and finally to all the speakers participating in the meeting.

J. A. Powell, University of California, Berkeley, and Thomas C. Emmel, Stanford University, Palo Alto, volunteered to act as the committee to investigate possible sites for the 1968 Pacific Slope Meeting. Finally, a motion was passed to reimburse the local arrangements chairman for his expenses.

In the time remaining before lunch, Richard Holland, the only member present who had attended the 1966 National Meeting at Ottawa, gave a brief report of that meeting. Lloyd Martin then adjourned the group to enjoy the fine luncheon provided by the Santa Barbara Natural History Museum.

The afternoon session convened with Charles Hogue presiding. The first paper, "A Collecting Trip to Newfoundland," was presented by Richard Holland of Albuquerque, New Mexico. Mr. Holland showed color slides of collecting sites and

commented on the lack of collecting in Newfoundland. Thirty-eight butterfly species and 249 moth species are recorded for the island; Holland collected 13 butterfly species and 12 species of moths.

The remainder of the afternoon session was devoted to a symposium on the biology of diurnal Heterocera. Ronald Leuschner of Gardena, California, began the symposium with a general survey of the day-flying phenomenon in his talk titled, "The Distribution and Variation of the Day-flying Habit in Moths." About four percent of the species of American macro moths are diurnal in habit. Variation in characteristics of flight, such as time of flight, and the occurrence of species flying both during the day and night hours were mentioned. Some reasons for the day-flying habit were suggested.

Frank Sala of Los Angeles, California, gave the next paper, "Taxonomy and Habits of Day-flying Moths." The members of the genus *Annaphila* (Noctuidae) found in southern California were used as examples. The distributions of the 14 species in the area were described in terms of favored habitats and areas of sympatry.

J. A. Powell, University of California, Berkeley, presented the final paper of the symposium, "Survey of Diurnal Microlepidoptera in California." Lack of time curtailed the presentation of prepared detailed data on *Adela*. Instead, Kodachromes of various representative microlepidoptera were shown. The point was made that lepidopterists have usually ignored these forms.

After some final remarks on diurnal heterocera and microlepidoptera, Dr. Hogue adjourned the afternoon session.

Saturday evening, members met at the El Encanto Hotel for a pleasant social hour and an excellent banquet. Lloyd Martin introduced the speaker for the evening, Thomas W. Davies of San Leandro, California. Mr. Davies spoke on his collecting experiences in Australia and New Zealand. The talk was illustrated with beautiful color slides of the unusual plants and animals that he had seen and the areas he had visited.

Ronald Leuschner presided over the Sunday morning session which began with a symposium on distributional patterns and geographic variability in butterflies. The first paper, "Zoogeography of the Genus *Boloria* in Western North America," was given by Jon H. Shepard of Stanford University. The distributions of the five species of the genus in this area were given and discussed. A good deal of the discussion was devoted to the *epithore* taxon.

The next paper, "The *Papilio machaon* group in California," was given by John F. and Thomas C. Emmel, of Stanford University. This paper was based on their studies of the variations, life histories, and distributions of this group. The distributions and zones of sympatry were given for the *polyxenes* sub-group. The *indra* subgroup was discussed in terms of geographic occurrence, habitats, and foodplant preferences.

O. E. Sette of Los Altos, California, gave the next paper, "Distributional Patterns of the Cupressaceae-feeding *Mitoura* Taxa in the Far West." This paper described the known distributions of some *Mitoura* forms in California and western Nevada. An area where *M. loki* meets *M. siva juniperaria*, and several areas where other forms nearly meet were described. A Cupressaceae-feeding *siva* form which is brown on the underside rather than green was reported from western Nevada.

Oakley Shields of La Mesa, California, presented the fourth paper, "Remarks on the Distribution of Some *Mitoura* Species." The variation between Colorado and California populations of *M. spinetorum*, and between northern Sierran and southern Sierran *M. johnsoni* was discussed. Lastly, a *Mitoura* population showing blending of characteristics of *M. s. juniperaria* and *M. loki* was discussed.

The symposium was completed with a summary paper given by Thomas C. Emmel on "Factors Affecting Distribution and Geographic Variation in Butterflies." The following factors were mentioned: foodplant specificity, tolerance to climatic bar-

riers such as deserts or wide rivers, migratory tendencies, vagility, and paleogeographic changes.

The final paper of the meeting, "Spiders and *Pseudohazis*," was given by David L. Bauer of Bijou, California. Mr. Bauer reported that male *Pseudohazis* were apparently seeking out and becoming entangled in the webs of spiders near Carson City, Nevada. The moths flew directly into the centers of the bushes where the spiders' webs were placed. *Pseudohazis hera* flew into the webs of the spider *Argiope trifasciata* and both *P. washingtonensis* and *eglanterina nuttalli* flew into the webs of the spider *Araneus gemma*. The possibility that the spiders produce a substance chemically related to pheromones known to be produced by female Saturniids of other genera was mentioned as one hypothesis.

The meeting was adjourned at noon after a brief business meeting.

The following 38 members of the society registered: Waldo Abbott, Nelson W. Baker, David L. Bauer, Peter F. Bellinger, Thomas Dimock, John F. and Thomas C. Emmel, Carl Goodpasture, C. F. Harbison, Chris Henne, Peter Herlan, Charles Hogue, Dick Holland, Peter Jump, Carl W. Kirkwood, John Lane, Robert Langston, Ronald Leuschner, Henry A. Madson, Lloyd M. Martin, Paddy McHenry, E. J. Newcomer, Paul A. Opler, J. A. Powell, Joe Roberds, A. Rubbert, Frank Sala, Ed and Scott Sampson, Elton Sette, Jon H. Shepard, Oakley Shields, Phil Smith, Ray Stanford, Fred Thorne, J. W. Tilden, Erich Walter, and Romain Young.

Respectfully submitted,

John Lane

Secretary *pro tempore*

New Host Plant Records for *Anthocaris* (Pieridae)

In the course of searching cruciferous plants for life history material representing the genus *Euchloe* for use in a revision of Nearctic species, eggs and larvae of *Anthocaris sara* Lucas and *A. lanceolata* Lucas were found on plants which represent new host records. The data for these collections are listed below. Determination of the *Arabis* and *Brassica* was confirmed by C. W. Sharsmith, San Jose State College.

Anthocaris sara

Arabis sparsiflora Nutt. var. *arcuata* (Nutt.) Roll.
Dry Crook, 3 miles south Piru Creek turnoff, Ventura County, California, 4 May 1964, eggs and larvae.

Barbarea vulgaris (L.)
Russelman Park, Mt. Diablo, Contra Costa County, California, 24 April 1966, larva.

Brassica Kaber (D.C.)
Strawberry Canyon, Alameda County, California, 18 April 1964, larva.

Descurrainea sp.
upper Cantillas Canyon, Sierra Juarez, Baja California del Norte, Mexico, 21 March 1967, larvae.

Sisymbrium officinale (L.) Scop.
Gates Canyon, Vaca Mountains, Solano County, California, 21 April 1966, larvae.

Anthocaris lanceolata

Arabis sparsiflora Nutt. var. *arcuata* (Nutt.) Roll.
Dry Creek, 3 miles west Piru Creek turnoff, Ventura County, California, 2 May 1964, larva.

P. A. Opler, University of California, Berkeley, California.

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Contributions to the *Journal* may be on any aspect of the collection and study of Lepidoptera. Articles of more than 20 printed pages are not normally accepted; authors may be required to pay for material in excess of this length. Manuscripts must be typewritten, ENTIRELY DOUBLE SPACED, employing wide margins and one side only of white, 8½ × 11″ paper. The author should keep a carbon copy of the manuscript. Titles should be explicit and descriptive of the article's content, including an indication of the family of the subject, but must be kept as short as possible. Authors of Latin names should be given once in the text. Format of REFERENCES MUST CONFORM TO EXACT STYLE used in recent issues of the *Journal.* Legends of figures and tables should be submitted on separate sheets.

Reprints may be ordered, and at least 25 gratis separates (including any other material published on these pages) will be provided, if requested at the time galley proof is received.

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Material not intended for permanent record, such as notices, current events, anecdotal field experiences, poems, philatelic Lepidoptera, etc. should be sent to the *News* Editor: E. J. NEWCOMER, 1509 Summitview, Yakima, Wash., U. S. A.

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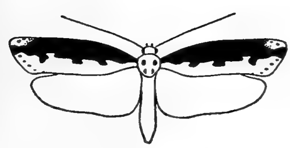

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28 November 1967

THE LEPIDOPTERISTS' SOCIETY
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The object of The Lepidopterists' Society, which was formed in May, 1947, and formally constituted in December, 1950, is "to promote the science of lepidopterology in all its branches, . . . to issue a periodical and other publications on Lepidoptera, to facilitate the exchange of specimens and ideas by both the professional worker and the amateur in the field; to secure cooperation in all measures" directed toward these aims (*Constitution*, Art. II). A special goal is to encourage free interchange among the lepidopterists of all countries.

Membership in the Society is open to all persons interested in any aspect of lepidopterology. All members in good standing receive the *Journal* and the *News of the Lepidopterists' Society*. Institutions may subscribe to the *Journal* but may not become members. Prospective members should send to the Treasurer the full dues for the current year, together with their full name, address, and special lepidopterological interests. All other correspondence concerning membership and general Society business should be addressed to the Secretary. Remittance in dollars should be made payable to *The Lepidopterists' Society*. There are three paying classes of membership:

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In alternate years a list of members of the Society is issued, with addresses and special interests. All members are expected to vote for officers when mail ballots are distributed by the Secretary annually. There are four numbers in each volume of the *Journal*, scheduled for February, May, August, November, and eight numbers of the *News* each year.

The Lepidopterists' Society is a non-profit, scientific organization. The office of publication is Yale University, Peabody Museum, New Haven, Connecticut 06520. Second class postage paid at Lawrence, Kansas, U.S.A. 66044.

Journal of The Lepidopterists' Society

Volume 21 | 1967 | Number 4

REVISION OF THE *LIMENITIS WEIDEMEYERII* COMPLEX, WITH DESCRIPTION OF A NEW SUBSPECIES (NYMPHALIDAE).

Stephen F. Perkins and Edwin M. Perkins, Jr.
Oregon Regional Primate Research Center, Beaverton, Oregon

Introduction

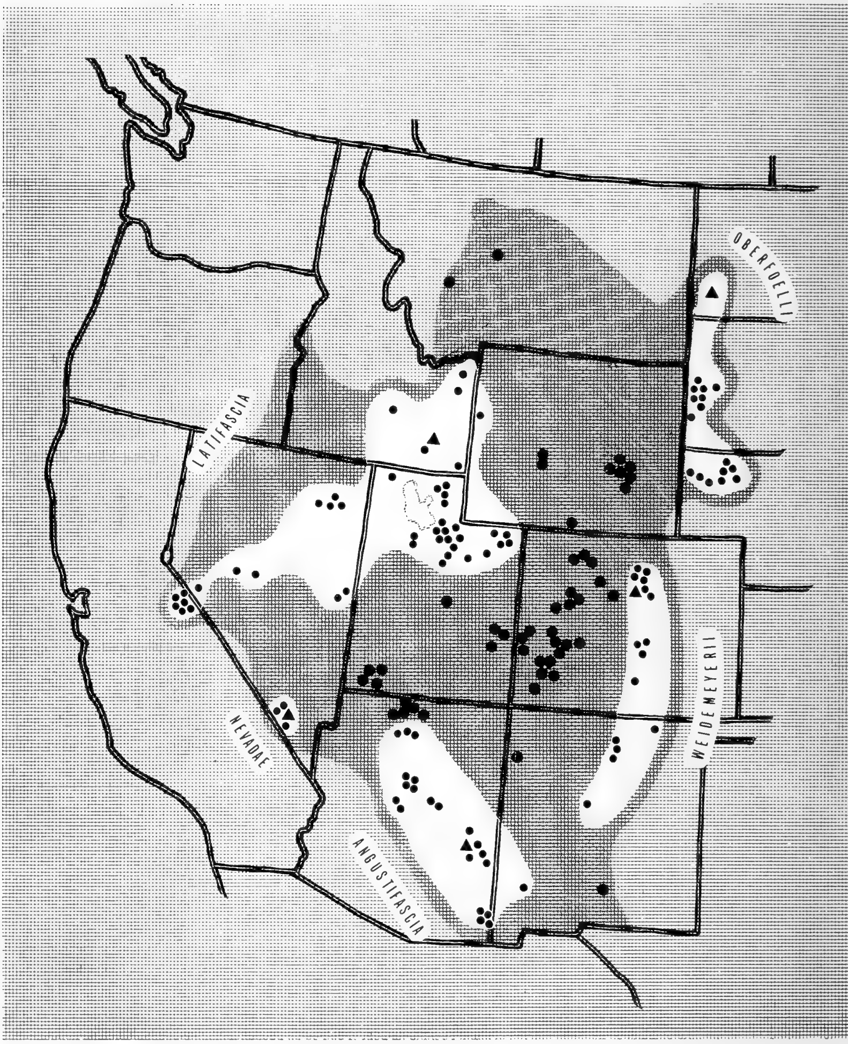
There is no single work which presents a comprehensive analysis of a given species group of the genus *Limenitis* Fabricius, 1807, in North America. Our present knowledge is largely dependent on R. L. Chermock's generic revision (1950). It seems peculiar that the scattered descriptions of specific and subspecific members of the North American *lorquini* complex of *Limenitis* were not presented as a unit until very recently (Perkins and Perkins, 1966). This second paper deals with the *Limenitis weidemeyerii* Edwards (1861) complex; historical background data, original descriptions, geographic ranges, and overt discrepancies are included.

Although the *weidemeyerii* complex inhabits nearly one-fifth the total area of the United States (Map 1), there is no evidence that components of the complex occur in either Canada or Mexico. In the United States *weidemeyerii* is established in Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah and Wyoming. In addition, stray individuals have been reported from Kansas (Field, 1938: 98) and Oregon (Fender, 1931: 185). The latter record, from the "foothills south of McMinnville," Yamhill County, probably was an import.

Limenitis weidemeyerii weidemeyerii Edwards
(figs. 1–4)

Limenitis weidemeyerii Edwards, 1862, Proc. Acad. Nat. Sci. Phil. [13]: 162, ["1861"].

Brown (1964: 222) inadvertently reversed the dates of publication for *weidemeyerii* and *Cercyonis pegala wheeleri* (Edwards, 1873). dos



EXPLANATION OF MAP 1

Distribution of *Limenitis weidemeyerii*: triangles denote type localities of respective subspecies; white areas delineate distribution of typical races; heavily shaded areas represent regions of intergradation and possible range extension. All circles indicate locales from which specimens were examined by the authors.

Passos (1964: 75) cites the date of publication for *weidemeyerii* as " '1861–3' (1861)" and Brown (1964: 211) restricts it to 1861, after 30 September and before 28 December.

The following is Edwards' original description:

"Expands 2.6 inch. *Male.*—Upper side brownish-black, with a broad common white band a little beyond the middle, making an obtuse angle within on the primaries and tapering towards the abdominal margin of secondaries, divided into long spots by the nervules; posterior to this band on secondaries an obsolete row of fulvous spots; within the hind margin of both wings a series of small white spots, minute on secondaries; between these and the band on costal margin of primaries a short transverse row of four white spots, the second largest, the fourth minute; crenations white. Under side paler, with a common white band and four white spots on primaries as above; on secondaries a row of fulvous spots posterior to the band; a little within the hind margin of both wings a series of large lunules cut transversely and unequally by a crenated black line parallel to the margin; these lunules are bluish-white except towards apex of primaries, where the inner row is white; on primaries a narrow ferruginous band upon the discal arc, followed within the cell successively by blue atoms, a bluish-white band and a ferruginous band, both narrow, transversely and oblique; next the base blue atoms; costa ferruginous; on secondaries the broad abdominal margin is bluish-white; the entire space between the band and the base is striped transversely with white and bluish-white, divided into spots by the nervules, with ferruginous lines between the stripe; costa white; body above black; beneath white, with a black stripe along the side of abdomen; palpi and legs white; antennae and club brownish-black."

The type locality for *weidemeyerii* was simply designated: "Rocky Mountains. From the collection of Mr. J. W. Weidemeyer." Edwards (Butterflies of North America, Vol. I.) further elaborated on the range of *weidemeyerii* by stating: "Found in Colorado; common in the vicinity of Pikes Peak, according to Mr. Ridings, who collected in that region in 1864." Brown (1960: 2) suggested that Edwards' type was collected by Wood, and has suggested (in litt.) restricting the type locality to an area "on the Platte River above Denver or in the Denver area." Finding no evidence to the contrary, the authors choose to accept Brown's recommendation. Since the type specimen no longer exists, a neotype (figs. 1 and 2) will be officially designated by Brown in his continuing series of papers dealing with W. H. Edwards' types of Nymphalidae.

ABERRATION NIGERRIMA (Cockerell)
(Holotype, figs. 32 and 33)

Basilarchia weidemeyerii ab. *nigerrima* Cockerell, 1927, Bull. So. Calif. Acad. Sci., 26(1): 5.

The dorsal and ventral photographs of the holotype offer sufficient, superficial descriptiveness to preclude the necessity of quoting from the text of the original description.

The type locality of *nigerrima* is Boulder, (Boulder County) Colorado. Described as an aberration, *nigerrima* must be treated as an infrasubspecific entity [Article 45. (d) (iii), International Code of Zoological Nomenclature].

ABERRATION SINEFASCIA Edwards, new status
(Holotype, figs. 34 and 35).

Limenitis weidemeyerii aber. *sine-fascia,* Edwards, 1882, Papilio (New York Ent. Club). 2 (2): 22.

Original Description:

"This extraordinary example lacks the broad, common white band on both surfaces, also the white patch in cell of primaries; all the submarginal and apical spots are present as in the type [typical]."

Although Edwards originally described *sinefascia* as an aberration, it has been treated as a subspecies for over forty years. The authors disagree with this ambiguous placement for the following reasons. During the year in which Edwards described *sinefascia,* the only transcendent, nomenclatorial Code in existence in the United States was the Dall Code of 1877. Although not conclusive, it is reasonable to suggest that Edwards did abide by the Dall Code because (1) of his affiliation with its organization and (2) it was the only systematic, as well as uniform, presentation of nomenclatorial standards then in existence. Articles LXVI, #3 (p.48) and LXXIII, (p.52—"or other subdivisions of a species"—) of the Dall Code support the contention that Edwards' use of the word aberration was not abstract, but intentional.

Conflicting opinions regarding the status of *sinefascia* have recently been based on interpretation of Article 45. of the I.C.Z.N. An opposing school of thought suggests that although Edwards used the word aberration, it is not to be interpreted as an express statement of infrasubspecific rank and, therefore, the name is available according to Article 45. (e) of the code. Article 45. (e) (i) specifies terms "variety" and "form" along with the statement that before 1961, the use of either term should not "be interpreted as an express statement of either subspecific or infrasubspecific rank." The word aberration is not mentioned although it is intimated in Article 1 (I.C.Z.N.) where reference is made to "teratological specimens" and their exclusion from the rules of the Code.

A second entity from Arizona, *L. angustifascia* (B. & McD.), which is discussed below, was described in 1912. Twelve years later Barnes and Benjamin (1924: 99) raised *sinefascia* to the level of subspecies. They did not apply a concept to it which had developed subsequent to the time of Edwards, but rather applied the rules set forth in the International Administration of Zoological Nomenclature (adopted in Berlin in 1901 and introduced, in English, in the United States in 1905). This Code emphasized the law of priority (whether or not a name was representative of an aberration). Thus, Edwards' *sinefascia* should have appeared as *Limenitis weidemeyerii sinefascia* (Barnes & Benjamin).

Having clarified the status of *sinefascia* (an aberration, both by the original description as well as by the superficial appearance of the holotype), it becomes evident that *angustifascia* represents the valid subspecies name of the narrow-banded race. Because Barnes and Benjamin raised *sinefascia* to a subspecific level, it now becomes necessary to reduce it to the original level of aberration thus enabling the name *angustifascia* to be given subspecific position. There are two methods by which this may be accomplished; (1) Article 23. of the I.C.Z.N. states: "The valid name of a taxon is the oldest available name applied to it. . . ." When Barnes and Benjamin raised *sinefascia* to a subspecific rank, *angustifascia* became the *oldest* available name by twelve years and (2) by reducing *sinefascia* to its originally described level of aberration (invoking Articles 45. (c), 45. (d) (iii) and 1. (I.C.Z.N.)), it would no longer be considered a part of the species group; thus, Articles 23. and 45. (e) (i) (I.C.Z.N.) would be irrelevant.

The first of these two methods is less acceptable because it would place *sinefascia* as a synonym of *angustifascia* (as much of an error as assigning a subspecific status to *sinefascia*). The second method permits *sinefascia* to be construed as an infrasubspecific entity, associated but not synonymous with *angustifascia*. Therefore, *sinefascia* is hereby returned to its original, infrasubspecific level of aberration, and *angustifascia* is resurrected to its originally described rank of subspecies.[1]

The type locality of *sinefascia* is questionable. Edwards cited the "vicinity of Tucson, Arizona." However, current data supports Prescott, Arizona as the type locality: (1) Bauer (1954: 129–130) described a specimen which he had collected in the Verde Valley region of central Arizona in 1952 as being similar to Edwards' *sinefascia*; (2) the locality label accompaning the holotype of *sinefascia* states: "Prescott, Arizona."; (3) Jacob Doll, who collected the holotype, was in the vicinity of Prescott in 1881; (4) another species from the same Doll lot (*Agathymus neumoegeni* (Edwards), 1882), was given the type locality—"southern Arizona." Freeman (1963: 139) corrected this locality designation to "approx. 9 mi. S. Prescott, Ariz." and (5) the known range of the Arizona subspecies of *weidemeyerii* does not encompass the vicinity of Tucson (including the Santa Catalina Mts., N.E. of Tucson).

Until conclusive evidence is uncovered, the type locality for *sinefascia* will have to remain questionable. The authors suggest that Prescott be given due consideration, however.

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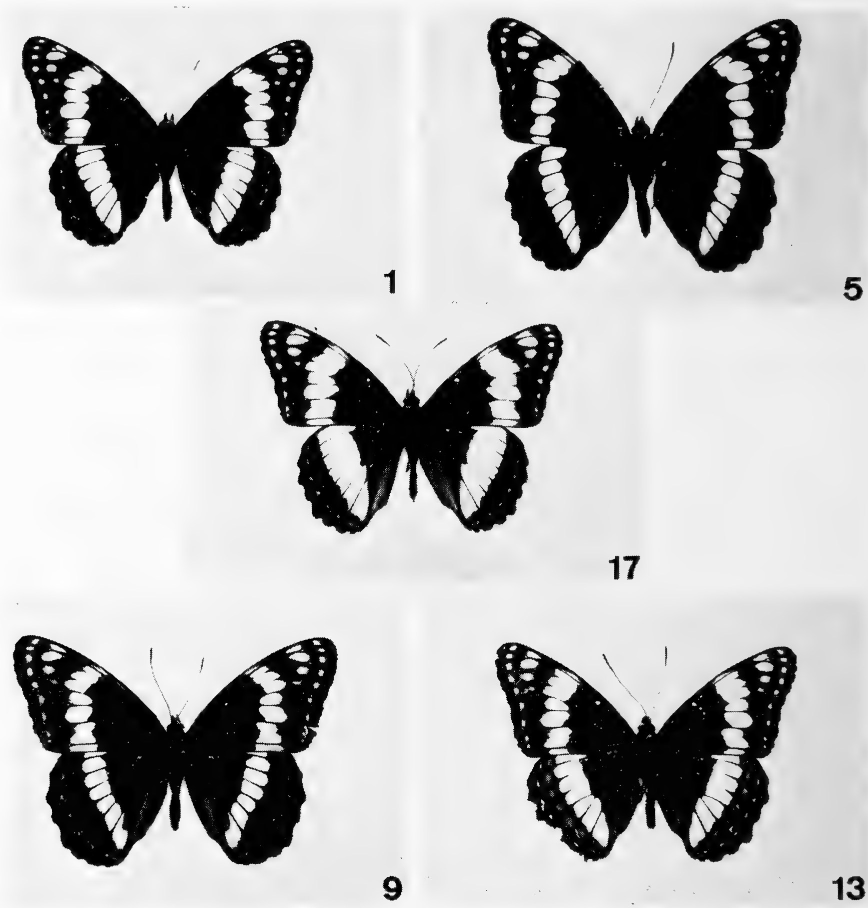
[1] Without the able assistance of N. D. Riley, and M. Doyle (on behalf of W. E. China) of the International Commission on Zoological Nomenclature, questions relative to the status and priority of *sinefascia* vs. *angustifascia* might still be unresolved.



EXPLANATION OF PLATE I

Dorsal adult ♂♂ of *Limenitis weidemeyerii* complex: 1) *weidemeyerii* Edwards (neotype), Lakewood, Jefferson Co., Colo., 11-VI-61; 5) *angustifascia* (B. & McD.) (topotype), Greer, White Mts., Apache Co., Ariz., 10-VII-53; 9) *nevadae* (B. & Benj.) (topotype), Kyle Canyon, Mt. Charleston, Clark Co., Nevada, 7-VI-62; 13) *oberfoelli* Brown, Lead, Lawrence Co., S.D., 24-VII-58; 17) *latifascia* Perk. & Perk. (holotype), 10 mi. S. Pocatello, Bannock Co., Idaho, 24-VI-41.

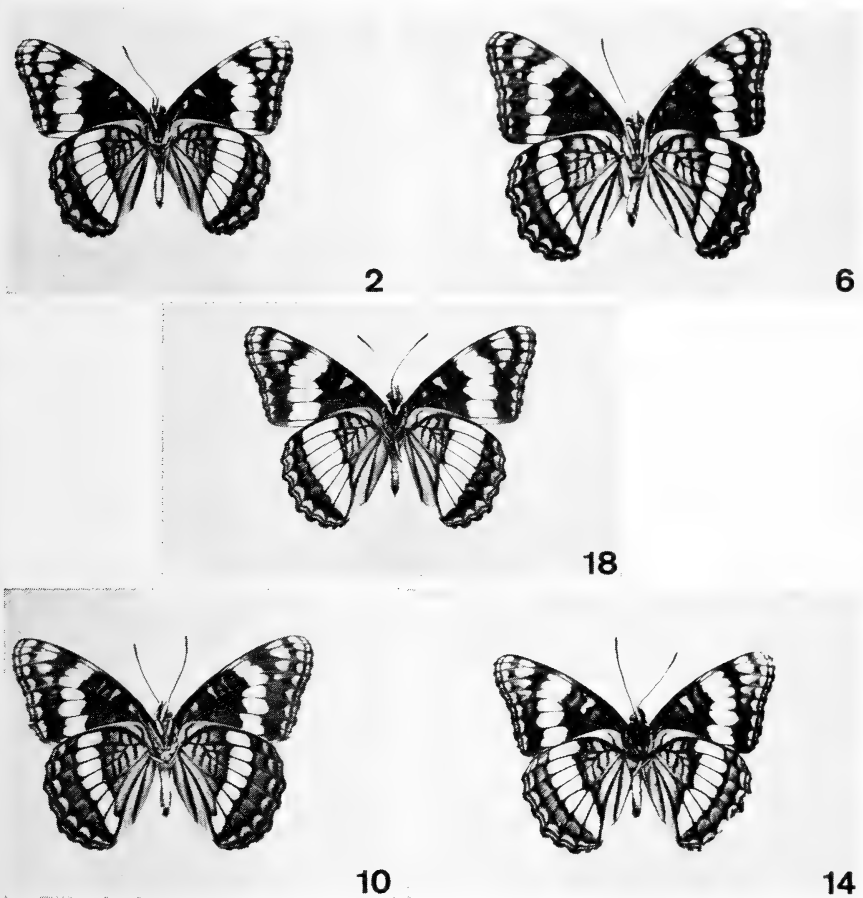
LIMENITIS WEIDEMEYERII ANGUSTIFASCIA (Barnes and McDunnough)

(figs. 5–8; Holotype, figs. 36 and 37)

Basilarchia weidemeyerii angustifascia Barnes and McDunnough, 1912, Canadian Ent. 44(5): 163.

The following is quoted from the original description:

"A series of 2 ♂ s and 5 ♀ s, collected last summer in the White Mts., Arizona, differs from the typical form from Colorado and Utah, as depicted by Edwards



Explanation of Plate II

Ventral Adult ♂♂ of *Limenitis weidemeyerii* complex, same specimens as in plate I: 2) *weidemeyerii*; 6) *angustifascia*; 10) *nevadae*; 14) *oberfoelli*; 18) *latifascia.*

(Vol. I, pl. 42), in that the median white band is much reduced in width, and the intersecting veins, especially on the primaries, are more broadly black. This difference is most noticeable in the ♀ s, the band on the primaries being distinctly broken up into an irregular row of white semiquadrate spots, of which the third from the costa is greatly reduced in size; on the secondaries the spots are *not* broader than long. As this feature is remarkably constant in all the specimens before us, and as, furthermore, we have had for years a ♀ labelled Arizona in the collection which shows the same peculiarities, we consider a varietal name for the Arizona form warranted; the extreme form of this race, in which the white band has entirely disappeared, is the ab. *sinefascia* Edw., also from Arizona. The males are normal in size, having a wing expanse of 2½ in. (63 mm.); the females are

somewhat larger than usual, all our specimens measuring 3 in. (76 mm.) The types are in coll. Barnes."

The type locality is cited "White Mts., Arizona." We further restrict this to: White Mountains, southeast of McNary, Apache County, Arizona. Specimens examined from various populations within this area (extending through the Blue Range in Greenlee County) compare favorably to the original description.

As was previously concluded, *angustifascia* (not *sinefascia*) represents the subspecific name for the southern, narrow-banded populations of *weidemeyerii*, exclusive of Nevada. Typical *angustifascia* is contained within a relatively small area (Map 1). In blend-zones such as Jacob Lake, Coconino County, Arizona, specimens of *angustifascia* may be phenotypically expressive of more than one race; e.g., the ventral ground color is often lighter and the dorsal, postmedian–median row of white spots is perceptibly wider.

Exploration of that region of northern Mexico, contiguous to southeastern Arizona, could be rewarding inasmuch as one peculiarity was noted, common to material from the Chiricahua Mountains of Cochise County; moderate, distinctive, ferruginous to red-brown scaling was conspicuous on the ventral primaries and secondaries of all specimens examined.

LIMENITIS WEIDEMEYERII NEVADAE (Barnes and Benjamin)

(figs. 9–12; Holotype, figs. 38 and 39)

Basilarchia weidemeyerii race *nevadae* Barnes and Benjamin, 1924, Contrib. Nat. Hist. Lepid. N. Amer., 5(3): 99.

Barnes and Benjamin described *nevadae* as follows:

"Not conspicuously different from some narrow banded specimens of *weidemeyerii* on the upper side, but quite uniformly narrow banded, practically as in the normal form, *augustifascia* [sic!], of the Aroniza [sic!] race *sinefascia*. The underside is conspicuously different from the described races, the normal red and orange-red markings being replaced by dull brown, those of the primaries being obsolete and almost lost in the blackish ground."

The holotype was collected in "Clark Co., Nevada." However, the type locality is herein restricted to the Spring Mountain Range of Clark County, Nevada; specimens from this area are the only ones in the western United States which are consistent with the original description.

It appears that the Mt. Charleston and other Spring Mountain Range material represents either a western extension of the Arizona subspecies *angustifascia* or a distinct isolate worthy of subspecific nomen. Geographic isolation, supression of ventral, red-orange maculation, and the presence of a bluish scaling on the medial half of the ventral secondaries

(unique to Spring Mountain Range material) lend support to the latter and the authors recommend that *nevadae* be accordingly treated as a subspecies.

Struck by the marked difference between Mt. Charleston specimens (*nevadae*) and those taken in the vicinity of Mono Lake, Mono County, California (formerly referred to as *nevadae*), the authors sought to elucidate this apparent discrepancy in terminology.

The examination of numerous specimens from the Great Basin of east-central California, Nevada, northwestern Utah, and southeastern Idaho; the Colorado Basin of northwestern Utah, and southwestern Wyoming; and the Pacific Northwest Basin of southeastern Idaho and west-central Wyoming disclosed that all shared characteristics possessed neither by *nevadae* nor by the other recognized races of *weidemeyerii* (Table I).

Limenitis weidemeyerii latifascia Perkins and Perkins, new subspecies
(figs. 17–20)

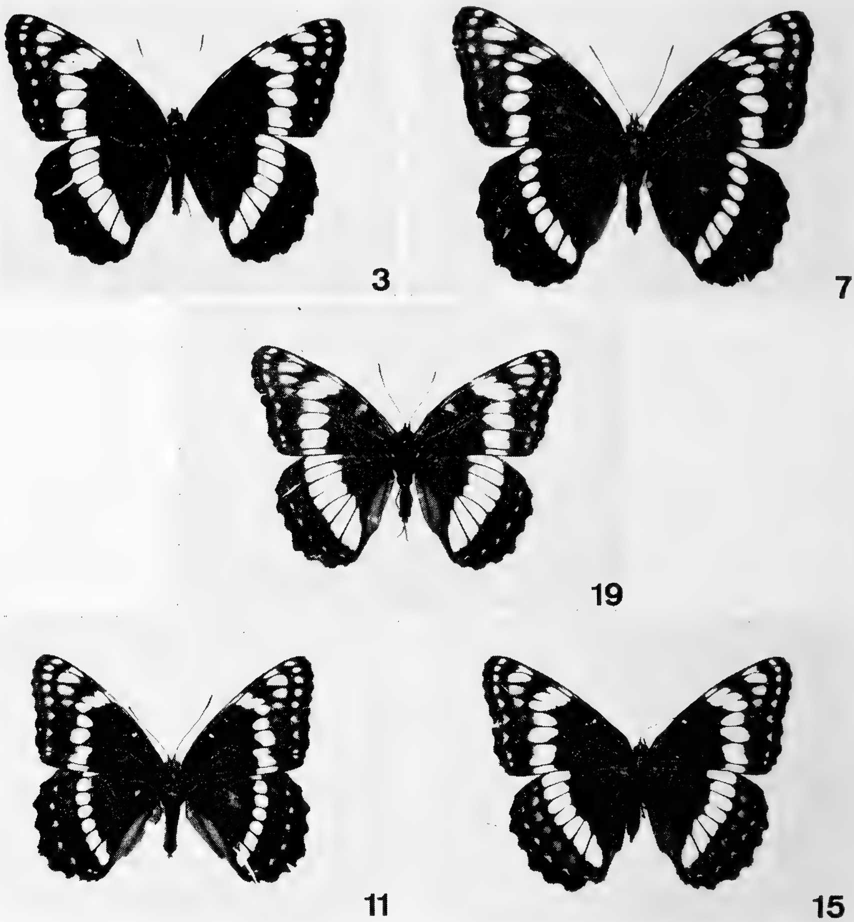
Males: Dorsal LFW (Expanse: 34.65 ± 1.39 mm.), holotype 34.95 mm.
Females: Dorsal LFW (Expanse: 39.18 ± 3.04 mm.), allotype 37.45 mm.

Differs from all other *weidemeyerii* subspecies by possessing overt, wide, post-median-median white bands on primaries and secondaries. Measurements of cell Cu_1 along vein Cu_1 on ventral RHW of 42 specimens indicate that ♂♂ have a value of 7.85 ± 1.06 mm. and ♀♀ have a value of 7.48 ± 2.15 mm. Ventral ground color least dark (white scaling extensive) compared to other *weidemeyerii* races. Submarginal lunules on ventral hindwings bluish-white. . . . seldom blue, blue-green or blue-violet. Males and females similar in appearance.

Holotype male: Idaho, 10 mi. S. Pocatello, Mink Creek, Bannock Range, Bannock Co., 24 June 41 (J. Manning), and Allotype, female, same locality, 19-VI-41 (J. Manning); placed in the collection of the American Museum of Natural History, New York City, New York.

Paratypes (27): IDAHO: Bannock Co., 10 mi. S. Pocatello, Mink Creek, Bannock Range, 13-VI-41, 16-VI-41, 17-VI-41, 19-VI-41 and 24-VI-41, 14 ♂♂, 3 ♀♀ (J. Manning); Fremont Co., Ashton, 14-VII-59, 1 ♂ (collector unknown). UTAH: Cache Co., Logan Canyon, northeast Logan, 1-VIII-64, 3 ♂♂ (J. Pease), Logan, VII-55, 1 ♂ (collecter unknown); Summit Co., City Creek Canyon, 23-VII-01, 1 ♀ (collector unknown—LACM coll. figs. 29–30); Utah Co., Payson Canyon, 20-VII-65, 2 ♂♂ (J. A. Justice), 6-VII-34, 2 ♂♂ (L. M. Martin—LACM coll.). Six ♂♂ have been deposited with the holotype and allotype; 7 ♂♂ and 1 ♀ have been deposited in the collection of the Los Angeles County Museum; 2 ♂♂ and 1 ♀ have been placed in both the California Academy of Sciences, San Francisco, California and the Smithsonian Institute of the United States National Museum, Washington, D. C. 2 ♂♂ have been deposited in the collection of F. M. Brown, Colorado Springs, Colorado and 4 ♂♂ and 1 ♀ have been retained by the authors.

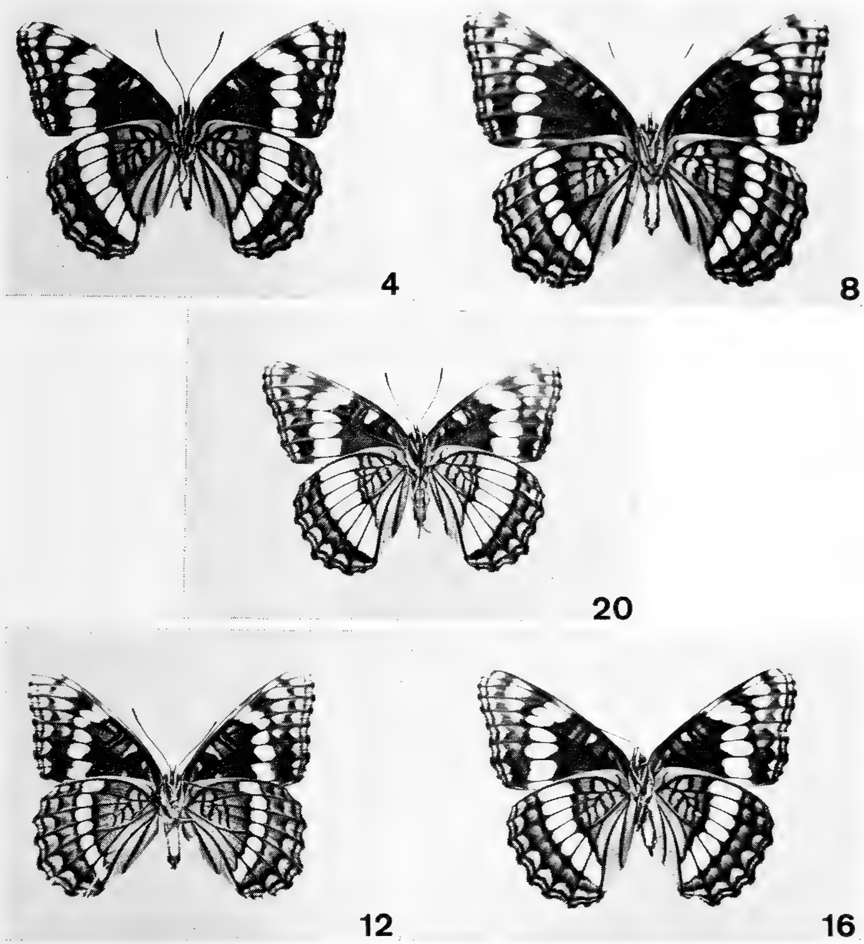
It should be noted that *latifascia* is encountered in southern Idaho, northern Utah, western Colorado, western Wyoming, northern Nevada,



Explanation of Plate III

Dorsal adult ♀♀ of *Limenitis weidemeyerii* complex: 3) *weidemeyerii* Edwards, Florissant, Teller Co., Colo., 6-VIII-65; 7) *angustifascia* (B. & McD.) Oak Creek Canyon, Coconino Co., Ariz., 16-VI-58; 11) *nevadae* (B. & Benj.) (topotype), Mountain Springs Pass, Clark Co., Nevada, 30-VI-63; 15) *oberfoelli* Brown, nr. Harrison, Sioux Co., Nebraska, 26-VI-62; 19) *latifascia* Perk. & Perk. (allotype), S. Pocatello, Bannock Co., Idaho, 19-VI-41.

and east-central California. In western Colorado, one may take specimens which resemble *w. weidemeyerii, w. latifascia,* or in the southwest portion of the state, *w. angustifascia*; however, the majority of specimens examined are closest in appearance to *w. latifascia* and not nominotypic *w. weidemeyerii.*



Explanation of Plate IV

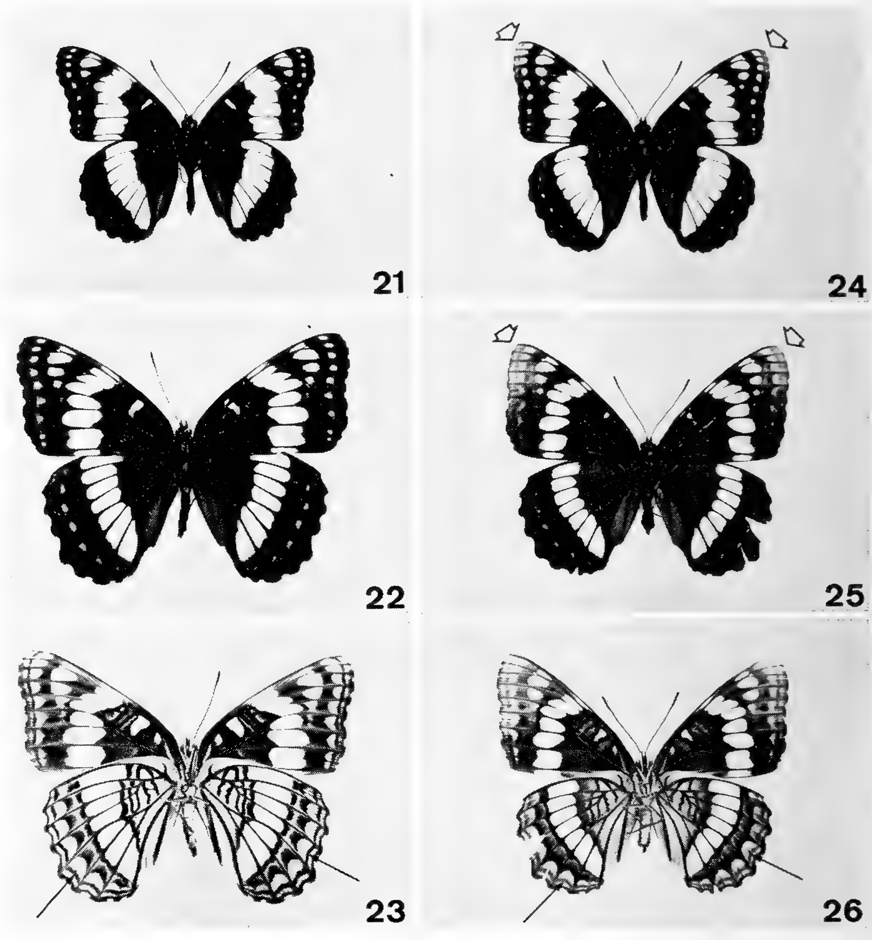
Ventral adult ♀♀ of *Limenitis weidemeyerii* complex, same specimens as in plate III: 4) *weidemeyerii*; 8) *angustifascia*; 12) *nevadae*; 16) *oberfoelli*; 20) *latifascia*.

HYBRID FRIDAYI (Gunder)
(figs. 24–26)

Basilarchia lorquini form *fridayi* Gunder, 1932, Canad. Ent., 64(12): 284.

The type locality of *fridayi* is "Leevening Creek [spelled Leevining Creek], near Mono Lake, Mono County, Calif." The holotype was not illustrated.

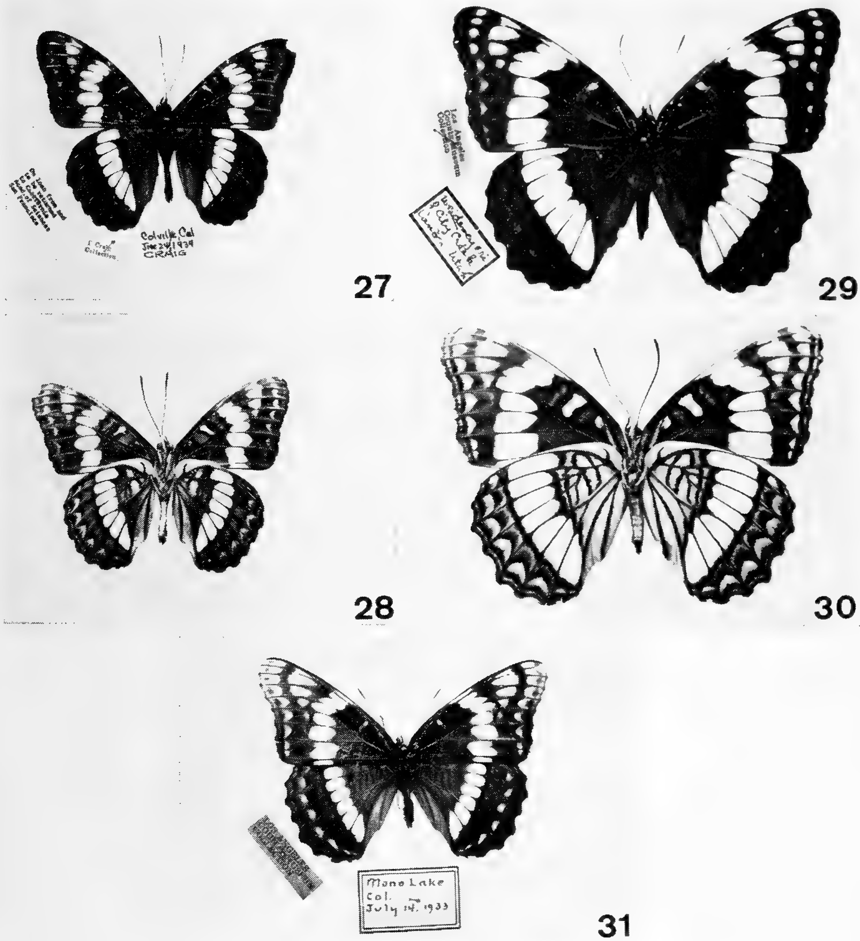
In discussing *fridayi,* Garth and Tilden (1963: 33) stated: "The



EXPLANATION OF PLATE V

Comparison of Mono Lake entities in *Limenitis*: 21) dorsal ♂ *latifascia,* Mono Lake, Mono Co., Calif., 20-VII-58; 22) dorsal ♀ *latifascia,* Mono Lake, Mono Co., Calif., 19-VII-33; 23) same, ventral aspect; 24) dorsal ♂ *fridayi* (topotype), Mono Lake, Mono Co., Calif., 16-VII-58; 25) dorsal ♀ *fridayi* (topotype), Mono Lake, Mono Co., Calif., 17-VII-58; 26) same, ventral aspect.

Nevada Admiral *nevadae* is a Great Basin race of the Rocky Mountain Weidemeyer's Admiral, *Limenitis* (L.) *weidemeyerii* (Edw.), found at Mono Lake on the eastern side of the Sierra Nevada. At Lee Vining, where its range overlaps that of the following species, *L.* (L.) *lorquini* Bdv., the hybrid *L.* (L.) *fridayi* (Gund.) occurs. Since the blend is an even one, in which the characteristics of neither species predominate,

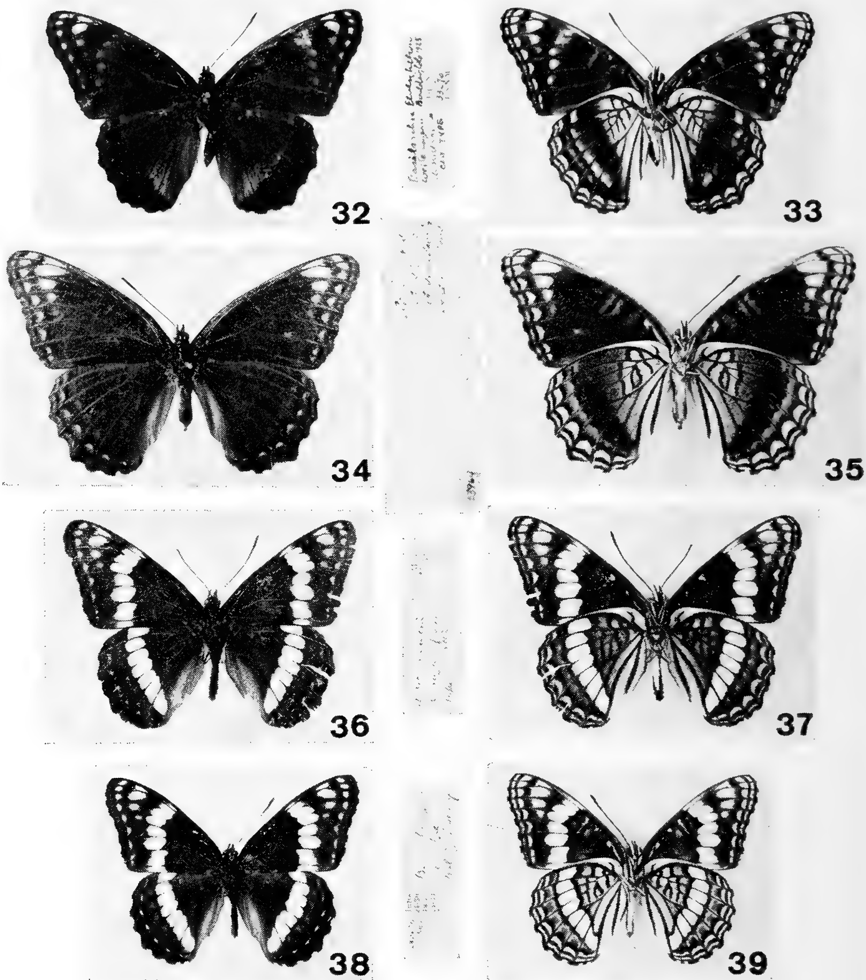


EXPLANATION OF PLATE VI

Limenitis species: 27) dorsal ♂ *lorquini,* Coleville, Mono Co., Calif., 24-VI-34; 28) same, ventral aspect; 29) dorsal ♀ *latifascia* (paratype), City Creek Canyon, Summit Co., Utah, 23-VII-01; 30) same, ventral aspect; 31) dorsal ♀ *fridayi* (topotype), Mono Lake, Mono Co., Calif., 14-VII-33.

we would prefer to indicate it as *L. w. nevadae* × *L. lorquini,* rather than as a form of the above." The present authors support this treatment of *fridayi* as a hybrid (as did also McDunnough, 1938: 22; Martin and Truxal, 1955: 19; and dos Passos, 1964: 75).

In appearance, *fridayi* generally exhibits a prominent, white submarginal ocellation, dorsally (similar to the Mono Lake *latifascia,* fig.



EXPLANATION OF PLATE VII

Type specimens (in *Limenitis weidemeyerii* complex): 32) dorsal ♂ *nigerrima* (type), Boulder, Colo., 1925; 33) same, ventral aspect; 34) dorsal ♀ *sinefascia* (type), Prescott, Arizona, no date; 35) same, ventral aspect; 36) dorsal ♂ *angustifascia* (holotype), White Mts., Arizona, no date; 37) same, ventral aspect; 38) dorsal ♂ *nevadae* (holotype), Clark Co., Nevada, 24–30 June; 39) same, ventral aspect.

22); this spotting often extends into the secondaries (fig. 31). Although only a means of defining an arbitrary section of a continuum, all *fridayi* specimens examined (including those in which the orange of the apices was lacking) possessed *one* distinction by which they could be readily

separated from *weidemeyerii latifascia.* Figure 26 (arrows) illustrates this distinction. It will be observed that the area medial to the submarginal lunules is lighter in appearance than the comparable area in figure 23. This lighter maculation is due to an orange replacement of black—a characteristic consistently noted in *fridayi* and found to be lacking in the Mono Lake *latifascia.*

Examples of *fridayi* are most commonly encountered within a 15 mile radius of Mono Lake; in this area *latifascia* and *fridayi* predominate—*lorquini* is rare.

The Mono Basin offers a fertile area for hybridization study; and, examples such as the *lorquini* specimen with the melanic apices (figs. 27–28), from Coleville, Mono County, California, only serve to add to the enigma of this region.

Limenitis weidemeyerii oberfoelli Brown
(figs. 13–16)

Limenitis weidemeyeri oberfoelli Brown, 1960, Amer. Mus. Novitates, 2018: 1–6.

F. Martin Brown (1960) described *oberfoelli* in order to make the name available for the faunal work by Puckering and Post (1960). However, dos Passos (1964) credits *oberfoelli* to "Puckering & Post, 1960" on the basis of priority. In their publication Puckering and Post attempt to credit the authorship of *oberfoelli* to Brown.

In following the International Code of Zoological Nomenclature, five Articles [numbers 13, 45 (b), 50, 72 (a), and 72 (b)], two Recommendations (numbers 73A and 73C) and four General Recommendations (numbers 1, 7, 17, and 23) are applicable to this problem. Brown's original description complies with all eleven Articles and Recommendations; Puckering and Post's publication violates all but Article 50. Of special interest are Article 45 (b), Recommendation 73A, and General Recommendation (Appendix E) 23; Brown complies with each of these, Puckering and Post comply with none. Furthermore, Article 50 automatically gives authorship to Brown since Puckering and Post consistently credit *oberfoelli* to and associate the name with F. Martin Brown. Therefore, Brown should be credited with the authorship of *oberfoelli.*

From Brown's original description, four of the primary distinctions (in comparison to typical *weidemeyerii*) are herein quoted:

(1)—dorsal primaries—"On the upper side of the forewing the submarginal row of white lunes tends to be more prominent on *oberfoelli* than on *weidemeyeri.*"

(2)—dorsal secondaries—"On seven of the nine North Dakota specimens before me, there is a well-developed row of reddish spots between the white submarginal lunes and the white band across the disc. None of the Colorado males before me presents these so boldly as does the average northern specimen."

TABLE I. COMPARISON OF THE FIVE RACES OF *Limenitis weidemeyerii*[1]

Race	*weidemeyerii*	*oberfoelli*	*angustifascia*	*nevadae*	*latifascia*
Number of typical specimens examined	21 ♂♂ 8 ♀♀	24 ♂♂ 7 ♀♀	60 ♂♂ 12 ♀♀	11 ♂♂ 5 ♀♀	35 ♂♂ 7 ♀♀
Geographic range	Rocky Mts. (east slope) Colo. & N.M.	N.D., S.D. & Nebraska	Arizona, S. Utah, W. New Mexico & S.W. Colorado	Spring Mts. of Nevada only	Idaho, N. Utah, N. Nevada, W. Wyo., W. Colo. & E. Cent. Calif.
♂ LFW radius (mm.)	33.96 ± 1.21	33.28 ± 2.43	36.35 ± 1.69	36.80 ± 3.35	34.65 ± 1.39
♀ LFW radius (mm.)	40.62 ± 6.89	38.84 ± 2.39	42.89 ± 4.25	37.80 ± 3.77	39.18 ± 3.04
♂ 99% limits med-postmed. white band (mm.)[2]	6.28 ± 0.80	6.43 ± 1.70	4.74 ± 0.88	4.65 ± 0.80	7.85 ± 1.06
♀ 99% limits med-postmed. white band (mm.)[2]	6.17 ± 2.01	6.16 ± 1.86	4.07 ± 1.73	3.65 ± 0.67	7.48 ± 2.15
Percent of individuals with orange spotting	24%	57%	18%	5%	34%
Percent of individuals with white in cell	77%	82%	33%	57%	92%
Darkness of ventral ground color	+++	++	+++++	++++	+
Ventral orange markings	Red-orange	Bright	Deep maroon	Blue scales	Lt. to dark
VHW submarginal lunules	Lt. blue	Lt. blue	Dark blue-green	Lt. blue-violet	Lt. blue-gray

[1] Based on the examination of 190 typical specimens (not including material from zones of intergradation).

[2] Through statistical analysis (following Brown, 1951: pp. 43–45) it was determined that the width of the white postmedian-median band does not vary in proportion to the overall size of the specimens' wings. Thus the width of this band may be used as a suitable differentiate among the subspecies of the *L. weidemeyerii* complex.

(3)—ventral primaries—"The red transverse marks within the cell of *oberfoelli* tend to be larger and redder and are more prominent than those of *weidemeyeri.*"

(4)—ventral secondaries—"The light markings of *oberfoelli* are broader and brighter than those of *weidemeyeri*, and the submarginal red is less suffused with dark scales . . . on the whole the underside of the hind wings of *oberfoelli* is the lighter and more delicately marked of the two."

The holotype and allotype are figured. The type locality is cited: "Badlands, Slope County, North Dakota."

The range of *oberfoelli* extends from the Slope County badlands of western North Dakota, south through the Black Hills of western South Dakota and the Pine Ridge region of northwestern Nebraska. The present authors were unable to acquire specimens from the eastern limits of Montana and northeastern Wyoming. However, this does not preclude the possibility that *oberfoelli* occurs in these areas.

In view of the preceding presentation, the authors recommend that the following, revised nomenclatorial treatment of the *weidemeyerii* complex be utilized:

w. weidemeyerii Edwards, "1861–2" (1861)
w. weidemeyerii Edwards, "1861–2" (1861)
  ab. *nigerrima* (Cockerell), 1927
w. angustifascia (Barnes & McDunnough), 1912
  ab. *sinefascia* Edwards, 1882
w. nevadae (Barnes & Benjamin), 1924
w. oberfoelli Brown, 1960
w. latifascia Perkins & Perkins, 1967
  hybrid *fridayi* (Gunder), 1932 (in part)

The following records represent the 529 examples of *Limenitis weidemeyerii* examined by the authors during the course of this study (collectors are listed alphabetically at the conclusion):

ARIZONA

APACHE CO.: White Mts., S.E. McNary, 23-VI-58, (D.D.); Greer, White Mts., 10-VII-53, (C.W.K.—LACM coll.); COCHISE CO.: Onion Saddle, Chiricahua Mts., 19-VI-60, (K.R.); Turkey Creek, Chiricahua Mts., 2-VII-65, (A.M.S.); Fly Park, Chiricahua Mts., 29-VI-65, 3-VII-65, (A.M.S.); Chiricahua Mts., 23-VI-08, 15-VI-16, (V.W.O.—LACM coll.); Paradise, (?), (J.A.C.—LACM coll.); COCONINO CO.: Oak Creek Canyon, 13 mi. N. Sedona, 4-VI-63, 15-VI-63, (F.T.T.); Cave Springs Camp, Oak Creek Canyon, 9-VIII-60, (D.D.); Oak Creek Canyon, 19-VI-56, 22-VIII-57, 16-VI-58, 8-VIII-60, (D.D.), 9-VI-63, 11-VI-63, (A.O.S.), 20-VI-55, (C.W.K.—LACM coll.); near Jacob Lake, Kaibab Forest, 10-VII-64, (K.B.T.); 6.8 mi. W. Jacob Lake, 3-VII-65, (T.C.E.); 9.9 mi. N. Jacob Lake, 5-VII-65, (T.C.E.); 11.2 mi. N. Jacob Lake, 23-VIII-64, (T.C.E.); Kanabownits, Grand Canyon National Park, 4/5-VII-47, (?—LACM coll.); Neal Springs, N. Rim Grand Canyon National Park, 22-VIII-64, (T.C.E.); 8 mi. N. Indian Gardens, Oak Creek Canyon, 9-VI-63, (K.R.); Roaring Springs, N. Rim Grand Canyon National Park, 22-VIII-64, (T.C.E.);

N. rim Grand Canyon National Park, 13-VII-36, (C.N.R.—LACM coll.); 13/14-VII-36, (D.M.—LACM coll.); GILA CO.: Christopher Creek, Mogollon Rim, 17-VI-57, (L.M.M., J.A.C., W.A.R.—LACM coll.); Tonto Creek State Fish Hatchery, Mogollon Rim, 25-VI-56, 21-VI-57, (L.M.M., J.A.C., W.A.R.—LACM coll.); Kohl's Ranch, Mogollon Rim, 23-VI-57, (L.M.M., J.A.C., W.A.R.—LACM coll.); GREENLEE CO.: Hannagan, 13-VII-52, (?); Hannagan Meadows, 2-VII-64, 3-VII-64, 4-VII-64, 5-VII-64, (R.F.S.), 1/3-VII-37, (D.M.—LACM coll.); Strayhorse Camp, 28/30-VI-37, (D.M.—LACM coll.); YAVAPAI CO.: 2 mi. S. W. Jerome, 8-VI-63, (A.O.S.), 17-VI-58, (D.D.); 2 mi. W. Jerome, 29-V-63, 14-VI-63, 23-VI-63, (F.T.T.).

CALIFORNIA

MONO CO.: Cottonwood Canyon, S. Bodie, 10-VII-64, 24-VII-65, (A.O.S.); N.W. corner Mono Lake, 6/7-VII-58, 16/17-VII-58, 20-VII-58, 30-VI-58, 24-VII-59, 26-VI-61, (A.O.S.); .75 mi. S. Mono Inn, Mono Lake, 24-VII-65, (A.O.S.); .5 mi. N.E. Mono Inn, Mono Lake, 1-VIII-65, 5-VIII-65, 19-VIII-65, (A.O.S.); Mono Lake, 11-VII-33, 19-VII-33, (C.B.—LACM coll.), 6-VII-35, 9-VII-35, 10-VII-35, 11-VII-35, 19-VII-35, 8-VII-36, 10-VII-36, (L.M.M.—LACM coll.), 4-VII-33, 14/15-VII-33, 25-VII-33, (?—LACM coll.); Bridgeport, 14-VII-37, (?—LACM coll.); Mono Basin, (?), (C.M.D.—LACM coll.); 9 mi. N. Lee Vining, 20-VIII-62, (M.R.L.—CAS coll.); 10 mi. N. Lee Vining, 6-VIII-61, (C.D.M., D.C.R., M.R.L.—CAS coll.), 9-VIII-61, (D.C.R., M.R.L.—CAS coll.); Lee Vining, 4-VII-61, (P.A.O.—CAS coll.).

COLORADO

ALAMOSA CO.: Great Sand Dunes National Monument, 25-VII-63, (T.C.E.); BOULDER CO.: Gregory Canyon, 9-VI-64, (J.A.J.); Stapps Lake, 29-VII-02, (H.C.—LACM coll.); DELTA CO.: 9 mi. W. Crawford, 14-VII-63, (T.C.E.); Lerorex Creek Road, 21-VI-65, (T.C.E.); EAGLE CO.: Gores Range, 5-VIII-02, 6-VIII-02, (J. & H.C.—LACM coll.); EL PASO CO.: Rocks Creek, 23-VI-62, (S.E.); FREMONT CO.: Oak Creek, 3-VII-32, (?—LACM coll.); GARFIELD CO.: 2.5 mi. E. Glenwood Springs, 20-VII-63, 24-VII-64, 13-VII-65, (T.C.E.); Roan Plateau, near Baxter Lake, 12-VII-62, (K.B.T.); Glenwood Canyon, 15-VI-62, (J.S.); Glenwood Springs, 11-VII-20, (R.A.L.—LACM coll.); GRAND CO.: 0.6 mi. S.E. Muddy Pass, 10-VII-63, (T.C.E.); Sulphur Springs, 10-VII-1898 (?—LACM coll.), 3-VIII-02, (J. & H.C.—LACM coll.); GUNNISON CO.: Erickson Springs Campground, 5 mi. E. Somerset, 15-VII-65, 22-VIII-65, (T.C.E.); Coal Creek, 20-VI-65, (T.C.E.), 23-VI-64, (S.E.); Gold Creek Canyon, Gunnison National Forest, 25-VII-63, (W.H.H.); JEFFERSON CO.: Lakewood, 11-VI-61, 10-VI-62, 12-VI-62, 24-V-63, 14-VI-63, 15-VI-64, (J.S.); LARIMER CO.: Pingree Park, 16-VIII-33, (F.M. & H.H.B.—LACM coll.); Rocky Mountain National Park, 4-VII-31, 12-VII-31, 14-VII-31, 15-VII-31, 24-VII-31, (?—LACM coll.); MESA CO.: Pinon Mesa, 2-VII-63, (T.C.E.); 10 mi. E. Gateway, 4-IX-65, (T.C.E.); MONTEZUMA CO.: Mesa Verde, 18-VI-56, (K.P.—LACM coll.); MONTROSE CO.: near Buckeye Reservoir, 21-VI-64, (S.E.); N. rim Black Canyon of the Gunnison National Monument, 25-VII-64, (T.C.E.); Uncompahgre Plateau, 11-VII-62, (K.B.T.); OURAY CO.: Sexter Creek, 25-VIII-65, (T.C.E.); ROUTT CO.: Rabbit Ears Pass, 17-VII-65, 7-VIII-64, (J.A.J.), 11-VII-62, (J.S.), 21-VII-59, (A.O.S.); 3.2 mi. W. Rabbit Ears Pass, 11-VII-63, (T.C.E.); SAN MIGUEL CO.: Telluride, 16-VII-?, (C.W.H.—LACM coll.); TELLER CO.: Big Springs Ranch, Florissant, 3-VIII-65, 6-VIII-65, (T.C.E.).

IDAHO

BANNOCK CO.: 10 mi. S. Pocatello, 13-VI-41, 16-VI-41, 19-VI-41, 22-VI-41, 24-VI-41, 10-VII-41, (J.M.); BEAR LAKE CO.: Bloomington, 15-VII-50, 13-VIII-50, (R.H.P.—USU coll.); BUTTE CO.: 1 mi. W. Craters of the Moon National Monument, 8-VIII-65, (E.M.P.); FREMONT CO.: Ashton, 14-VII-59, (?); Ripley Butte, Island Park, 17-VI-57, (B.K.—USU coll.).

Montana

Lewis & Clark Co.: Helena, 11-VIII-07, (W.M.M.—LACM coll.); Powell Co.: Race Track Creek Canyon, 20 mi. N. Anaconda, 21-VII-65, 22-VII-65, 26-VII-65, (H.H.).

Nebraska

Dawes Co.: Chadron State Park, Pine Ridge, 16-VI-61, (K.J.); 5 mi. S. Chadron, Pine Ridge, 19-VI-65, (E.S.N.); Deadhorse Canyon, Pine Ridge, 2-VII-65, 3-VII-65, (E.S.N.); Whitney, 17-VI-65, (E.S.N.); Kings Canyon, Pine Ridge, 4-VI-65, 6-VII-65, (E.S.N.); Chadron, (?), (M.W.); Sioux Co.: Sowbelly Canyon, Pine Ridge, 20-VI-64, (K.J.), 26-VI-62, (J.C.D.); Monroe Canyon, N. Harrison, 26-VI-62, (J.C.D.).

New Mexico

Colfax Co.: Raton, 20-VII-64, (J.R.M.); Grant Co.: Cherry Creek, Pinos Altos Mts., 10-VI-58, (J.P.H.); McKinley Co.: Ft. Wingate, 8-VI-09, 14-VI-09, 3-VII-09, (J.W.—LACM coll.); Otero Co.: near Cloudcroft, 20-VII-58, (A.N.); Sandoval Co.: Las Huertes Canyon Road, 5.6 mi. S. Placitas, Sandia Mts., 15-VII-63, (T.C.E.); Juan Tabo, Sandia Mts., 8-VII-45, (W.O.G.—LACM coll.); Taos Co.: Hondo Canyon, near Taos, 19-VIII-64, (T.C.E.).

Nevada

Clark Co.: Charleston Mtn. Park, Kyle Canyon, 10-VIII-63, (T.C.E.), 6-VI-52, 7-VI-52, (T.D.), 2-VII-36, (D.M.—LACM coll.), 29-VII-66, (E.M.P.); Mountain Springs Pass, Spring Mtn. Range, 30-VI-63, (K.R.); Elko Co.: Spruce Mtn., 18-VII-60, (J.B.); Lamoille Canyon, Ruby Mts., 19-VII-60, (J.B.), 24-VII-59, (A.O.S.), 10-VII-58, (W.A.H.); Ruby Valley, 20-VI-33, (L.M.M.—LACM coll.); Lander Co.: Kingston Canyon, Toiyabe Mts., 20-VII-64, (T.C.E.); Hy. 50, S. Carroll Summit, 13-VII-59, (A.O.S.); Mineral Co.: Corey Creek Canyon, 17-VII-65, (P.J.H.); White Pine Co.: Snake Creek, Mt. Wheeler, 1-VII-60, (W.A.H.); Lehman Creek, Mt. Wheeler, 1-VII-60, (W.A.H.).

South Dakota

Custer Co.: W. of Custer, "1929–1930," (J.M.); Lawrence Co.: Spearfish Canyon, Black Hills National Forest, 25-VII-58, 23-VI-61, (E.M.P.), 23-VI-61, (S.F.P.), 12-VIII-65, (T.C.E.); Lead, 24-VII-58, (E.M.P.); Meade Co.: Bethlehem, 29-VI-63, (W.B.); Pennington Co.: Deerfield Lake, 26-VII-58, (S.F.P.); .25 mi. E. Black Fox Campground, 26-VII-58, (E.M.P.).

Utah

Box Elder Co.: near Holstein R. S., Raft River Mts., 23-VII-63, (J.S.); Cache Co.: Logan Canyon, N.E. Logan, 20-VII-48, (G.G.F.—USU coll.), 18-VI-54, 9-VII-54, (R.P.O.—USU coll.), 13-VII-48, (B.H.—USU coll.), 10-VII-48, (R.S.B.—USU coll.), VI-54, (?—USU coll.), VII-53, (H.A.A.—USU coll.), 14-VIII-59, (?—USU coll.), VII-55, (?); Green Canyon, 2-VII-54, (D.W.D.—USU coll.), 27-VII-64, (W.J.H.—USU coll.); Blacksmith Fork Canyon, 10-V-60, (W.A.R.—USU coll.); Daggett Co.: Palisade Park Camp, 20-VII-62, (R.Y.—USU coll.), 20-VII-63, (C.G.—USU coll.), 19-VII-62, (B.A.H.—USU coll.); Ashley Dam, 17-VI-62, (J.S.); Davis Co.: Muller Park, Wasatch Mts., 11-VI-65, (K.B.T.); Duchesne Co.: Roosevelt, 14-VIII-37, (F.C.H.—USU coll.); near Fruitland, 8-VIII-63, (K.B.T.); Grand Co.: Castle Valley, 9-VI-63, (J.R.P.); Mill Creek, La Sal Mts., 11-VII-62, (K.B.T.); Iron Co.: Midway Summit, Hy. 14, 9-VIII-63, (T.C.E.); Salt Lake Co.: Big Cottonwood Canyon, Mill River Fork, 2-VII-65, (K.B.T.); Salt Lake City, 5-VI-59, (J.R.P.—USU coll.), 14-VIII-25, (L.V.B.—LACM coll.); Lamb's Canyon, Wasatch Mts., 21-VII-64, 14-VII-64, 5-VII-62, (K.B.T.); City Creek Canyon, 22-VI-60, (J.C.D.); San Juan Co.: Brumley Ridge, road to Geyser

Pass from Moab, 22-VII-64, (T.C.E.), 23-VI-63, (K.B.T.); SANPETE Co.: Ephraim Canyon, 28-VI-34, (L.M.M.—LACM coll.); SUMMIT Co.: N. Fork Provo River, Uinta Mts., 18-VII-65, (J.A.J.); Shingle Creek, Uinta Mts., 12-VII-65, (K.B.T.); Park City, 28-VII-1895, (?—LACM coll.); TOOELE Co.: South Willow Canyon, Stansbury Mts., 20-VII-64, 30-VII-64, 1-VII-65, 18-VII-65, 21-VII-65, 5-VIII-65, (K.B.T.), 19-VII-65, 21-VII-65, (J.A.J.); UINTAH Co.: Merkley Park, 29-VIII-65, (K.B.T.); Kabell Hollow, Uinta Mts., 12-VII-63, 14-VII-63, (K.B.T.); UTAH Co.: 6 mi. E. Timpanogos Cave National Monument, 8-VII-65, (T.C.E.); Payson Canyon, 20-VII-65, (J.A.J.), 7-VII-64, 20-VII-65, (K.B.T.), 22-VI-34, 6-VII-34, (L.M.M.—LACM coll.); WASHINGTON Co.: Leeds Canyon, Pine Valley Mts., 19-VI-64, (K.B.T.); Pine Valley, 6-VII-36, (C.N.R.—LACM coll.); near St. George, 4-VII-25, (J.A.C.—LACM coll.).

WYOMING

ALBANY Co.: La Bonte Canyon, 4-VII-63, (R.H.); Eagle Peak, 14-VII-63, (R.H.); CONVERSE Co.: Mill Creek, 9-VIII-64, (R.H.); La Prele Canyon, 23-VI-64, (R.H.); Cold Springs, Medicine Bow National Forest, 23-VI-63, (R.H.); Camel Creek, 19-VII-64, 15-VII-65, (R.H.); CARBON Co.: 9 mi. W. Encampment, Sierra Madre Mts., 9-VII-60, (J.C.D.); FREMONT Co.: Louis Lake, Shoshone National Forest, 18-VII-63, (E.M.P.); TETON Co.: 4 mi. W. Teton Pass, Targhee National Forest, 8-VIII-65, 10-VIII-65, (E.M.P.).

INDEX OF COLLECTORS

(H.A.A.) H. A. Arfaa; (R.S.B.) R. S. Bailey; (J.B.) J. Baker; (W.B.) W. Boscoe; (L.V.B.) L. V. Bower; (C.B.) C. Brown; (F.M.B.) F. M. Brown; (H.H.B.) H. H. Brown; (H.C.) H. Comstock; (J.A.C.) J. A. Comstock; (C.M.D.) C. M. Dammers; (T.D.) T. Davies; (D.W.D.) D. W. Davis; (D.D.) D. Dirks; (J.C.D.) J. C. Downey; (S.E.) S. Ellis; (T.C.E.) T. C. Emmel; (G.G.F.) G. G. Fleener; (C.G.) C. Granam; (W.O.G.) W. O. Griesel; (W.A.H.) W. A. Hammer; (W.J.H.) W. J. Hanson; (R.H.) R. Hardesty; (F.C.H.) F. C. Harmston; (B.H.) B. Harris; (B.A.H.) B. A. Haws; (P.J.H.) P. J. Herlan; (C.W.H.) C. W. Herr; (H.H.) H. Holmes; (W.H.H.) W. H. Howe; (J.P.H.) J. P. Hubbard; (K.J.) K. Johnson; (J.A.J.) J. A. Justice; (C.W.K.) C. W. Kirkwood; (B.K.) B. Knapp; (R.A.L.) R. A. Leussler; (M.R.L.) M. R. Lundgren; (C.D.M.) C. D. MacNeill; (W.M.M.) W. M. Mann; (J.M.) J. Manning; (L.M.M.) L. M. Martin; (D.M.) D. Meadows; (J.R.M.) J. R. Merritt; (E.S.N.) E. S. Nixon; (A.N.) A. Nymeyer; (R.P.O.) R. P. Olson; (P.A.O.) P. A. Opler; (V.W.O.) V. W. Owen; (J.R.P.) J. R. Pease; (E.M.P.) E. M. Perkins, Jr.; (S.F.P.) S. F. Perkins; (R.H.P.) R. H. Piggott; (K.P.) K. Phillips; (W.A.R.) W. A. Reese; (D.C.R.) D. C. Rentz; (K.R.) K. Roever; (W.A.R.—USU coll.) W. A. Rowley; (C.N.R.) C. N. Rudkin; (J.S.) J. Scott; (A.M.S.) A. M. Shapiro; (A.O.S.) A. O. Shields; (R.F.S.) R. F. Sternitzky; (F.T.T.) F. T. Thorne; (K.B.T.) K. B. Tidwell; (M.W.) M. Wood; (S.L.W.) S. L. Wood; (J.W.) J. Woodgate; (R.Y.) R. Young.

Museum collections are indicated as follows: (CAS coll.) California Academy of Sciences, San Francisco, California; (LACM coll.) Los Angeles County Museum, Los Angeles, California; (USU coll.) Utah State University, Logan, Utah.

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DESCRIPTION OF A NEW SPECIES OF *ANEPIA* HAMPSON FROM THE SIERRA NEVADA OF CALIFORNIA (NOCTUIDAE)

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In recent years the authors have obtained a series of a new noctuid which belongs in the genus *Anepia* Hampson, close to *amabilis* (Barnes and McDunnough). At first, only a few specimens were at hand, and it was difficult to be sure of the specific integrity of the new species. As more material became available, it was apparent that there were two species involved, and with further study, the distinctness became more obvious.

The genus *Anepia* as presently recognized, is composed of seven North American species, including *plumasata* herein described as new. *A. amabilis* was described from Loma Linda, San Bernardino County, California, and this species seems to inhabit areas from sea level up to over 1,000 feet elevation. *A. plumasata,* on the other hand, inhabits more mountainous areas from 1,000 to over 8,000 feet elevation, and is more northerly in distribution.

A. amabilis is well described by Barnes and McDunnough (1918), including a photograph (plate 16, figure 4). Draudt (*In* Seitz, 1923) depicts *A. amabilis* in color (plate 17, row k), but this illustration is inaccurate in color, as it is much too yellowish brown.

Anepia plumasata Buckett and Bauer, new species

Holotype male: Ground color bluish grey, due to whitish scaling over darker background. *Head* with vertex clothed with spatulate and flattened hairs, basally brownish, apically white tipped; frons appearing brownish, clothed with spatulate hairs, flattened hairs, simple hairs; palpi brown with scattering of white scales, elongate brownish simple hairs protruding ventrally; antennae with scape clothed in whitish spatulate scales, basally with flagellar segments slightly cleft, medially with each segment truncate ventrally, medial ciliations as long as width of flagellar shaft, lessening in length apically. *Thorax* dorsally with collar clothed basally in greyish hairs and scales; medially with an indistinct, broad black band, preapically greyish, apically white tipped; disc clothed in simple and spatulate hairs, basally greyish, apically white tipped; tegulae clothed as in disc, except spatulate hairs represented by spatulate scales; ventrally clothed in whitish or ash-grey, simple hairs, appearing peppered; tarsal segments black, with white annuli apically; tarsal claws (or ungues) serrate ventrally. *Forewings* dorsally with basal half line slightly outcurved, basally black, apically whitish; transverse anterior area of ground color, heavily overlain with white scales; transverse anterior line slightly outcurved, undulating from costa to inner margin, geminate, basally whitish, terminally black; median area black preceding orbicular and including claviform, remainder of median

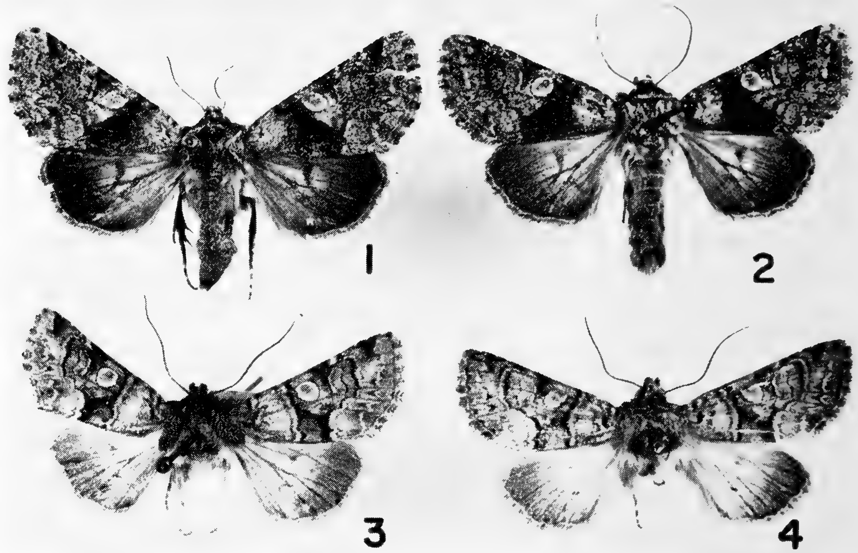


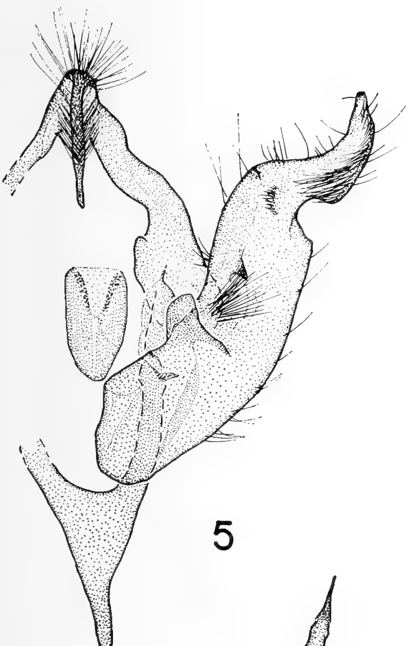
Fig. 1. *Anepia plumasata* Buckett and Bauer, allotype female. Johnsville, Plumas Co., Calif., 18 June 1963. Fig. 2. *A. plumasata,* Holotype male. Same locality, 18 June 1946. Fig. 3. *A. amabilis* (Barnes and McDunnough), male. Del Mar, San Diego Co., Calif. 7 May 1943. Fig. 4. *A. amabilis,* female. Ojai, Ventura Co., Calif., 10 April 1955.

area of ground color; claviform large, from half-way to completely across median area, not easily discernable because of darker scales surrounding it; orbicular thinly outlined in brownish-black, externally whitish, centrally filled with ground color; reniform erect, rectangular, colored as in orbicular; transverse-posterior line evenly curved outwardly around reniform, appearing geminate toward inner margin, basally black, terminally white; sub terminal area of ground color, veins faintly outlined in black; sub terminal line a black wedge on costa, thence disjunct, remainder white; terminal line faintly represented by black lunules between veins; fringes checkered with alternating whitish and bluish-grey checks; ventral surface brownish-black; reniform weakly represented in black; transverse-anterior line broad, represented in black; terminal area heavily irrorated with white scales; fringes as in dorsal surface. *Hindwings* dorsally deep smokey fuscous, lighter basally; discal lunule represented in dark brown; fringes tricolored, basally ochreous, medially dark-brown, apically whitish; ventral surface charcoal with irroration of white scales; discal lunule present as black dot; exterior line black; area extending from exterior line just proximally to fringes darker than ground color of wing; fringes as in dorsal surface.

Greatest expanse of forewing 15 mm. Genitalia as in figs. 5 and 7.

→

Fig. 5. *Anepia plumasata* Buckett and Bauer, paratype. Male genitalia, aedeagus removed. Same locality as in fig. 1, 6 July 1962. Bauer-Buckett slide No. 65A6-7. Fig. 6. *A. amabilis* (B. & McD.). Male genitalia aedeagus removed. Data same as fig. 3, Bauer-Buckett slide No. 65A6-5. Fig. 7. *A. plumasata,* paratype male aedeagus. Data same as in fig. 5. Fig. 8. *A. amabilis,* male aedeagus. Data same as in fig. 6.



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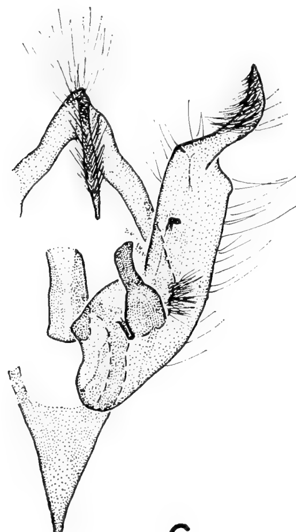

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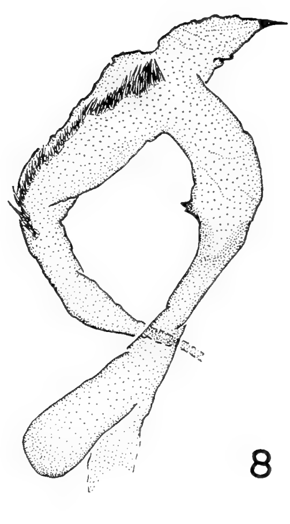

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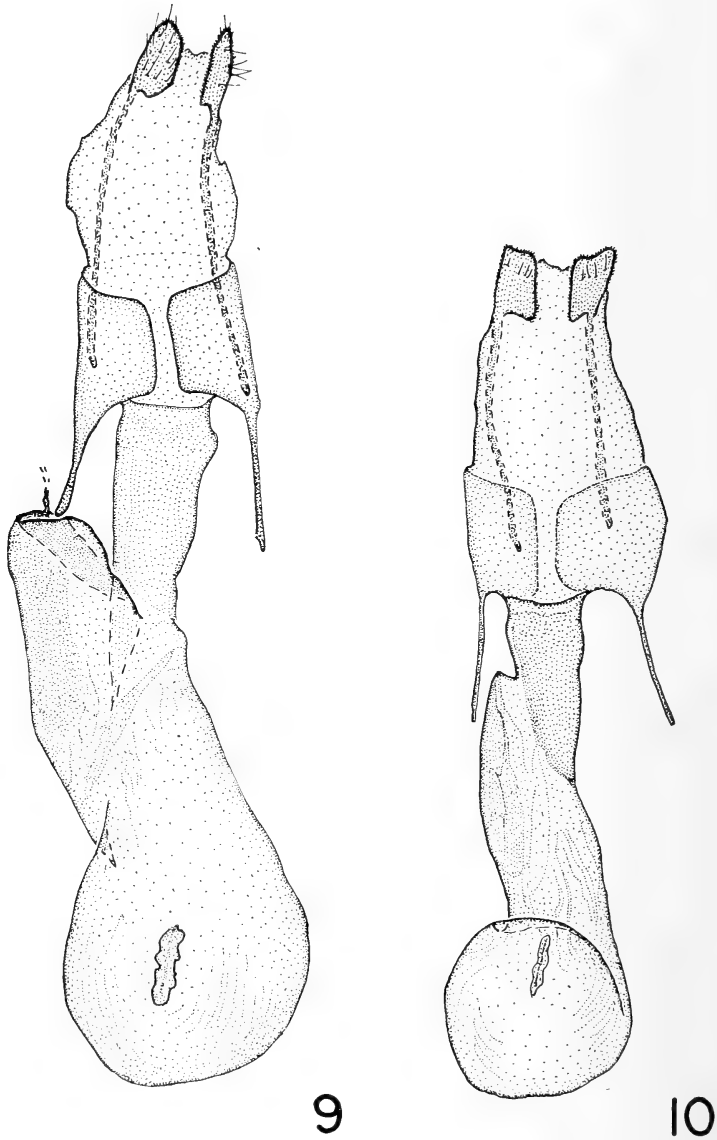

Fig. 9. *Anepia plumasata* Buckett and Bauer, Paratype. Female genitalia. Johnsville, Plumas Co., Calif. 25 June 1962 (H. J. Pini), Bauer-Buckett slide No. 65A6-8.
Fig. 10. *A. amabilis* (B. & McD.), female genitalia. Del Mar, San Diego Co., Calif. 28 May 1956 (J. A. Comstock), Bauer-Buckett slide No. 65A6-6.

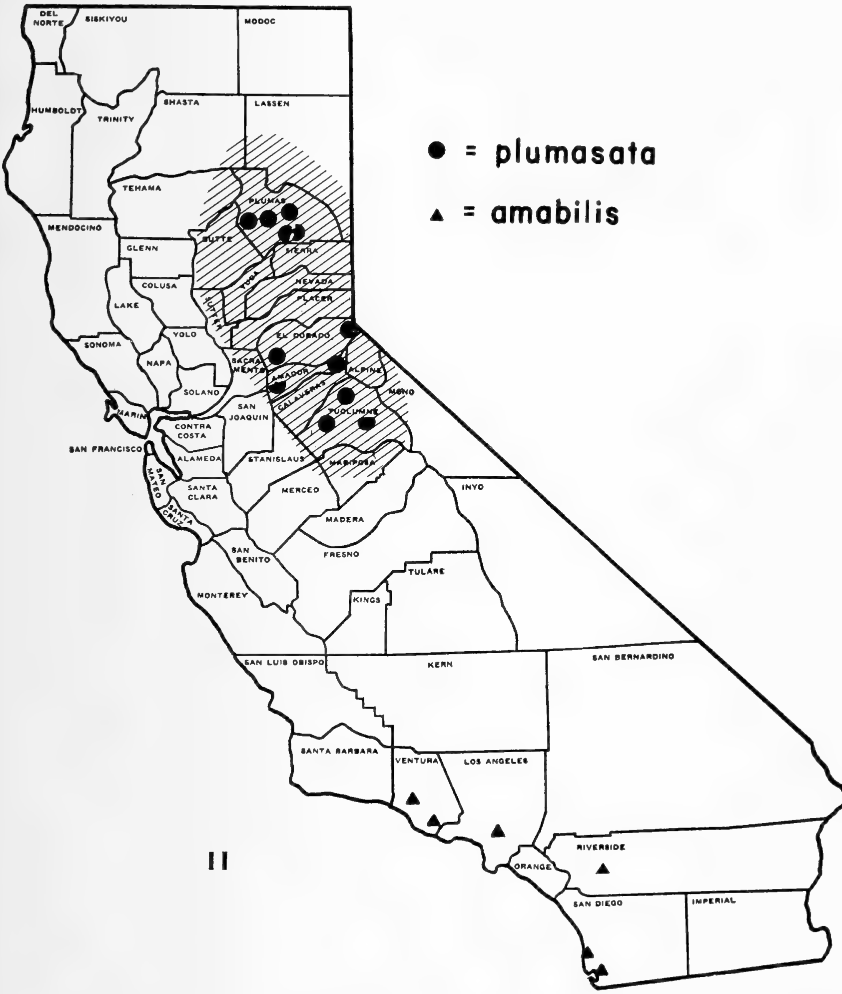

Fig. 11. Distribution of *Anepia plumasata* Buckett and Bauer and *A. amabilis* (B. & McD.) based on material studied.

Female: As in male except antennal ciliations shorter; maculation of wings usually more obscure.

Greatest expanse of forewing 16 mm. Genitalia as in fig. 9.

Holotype male: CALIFORNIA, Johnsville, Plumas Co., 18 June, 1964. (H. J. Pini). Paratypes: 1 ♀ (designated allotype), same locality and collector as preceding, 18 June, 1963. 1 ♂, Plymouth, Amador Co., 1 June, 1963 (T. Gallian); 1 ♀, Silver Lake, Amador Co., 17 July, 1935 (Carter); 1 ♂, 1 ♀, Bijou, El Dorado Co., 25 July, 1964 (R. A. Young); 1 ♂, Placerville, El Dorado Co., 5 June, 1965 (R. A. Y.); 1 ♂, 1 mi N

Elephant Butte, 16 June, 1964 (J. S. Buckett & M. R. Gardner); 1 ♂, Johnsville, Plumas Co., as follows: 1 ♂, 24 June, 1959 (W. R. Bauer & J. S. B.); 1♂, 5 June, 1960 (W. R. B. & J. S. B.); 1♀, 25 June, 1962 (H. J. P.); 2♂, 1♀, 6 July, 1962 (H. J. P.); 1♂, 7 June, 1963 (H. J. P.); 1♂, 1♀, 24 July, 1964 (H. J. P.); 1♂, 6 June, 1965 (H. J. P.); 1♂, Mohawk, Plumas Co., 20 June, 1946 (W. R. B.); 1 ♀, Mt. Ingalls, Plumas Co., 24 July, 1964 (J. S. B. & M. R. G.); 1 ♀, 1 mi N Quincy, Plumas Co., 14 June, 1964 (Gus Jeskey); 1 ♂, 2 ♀, Strawberry, Tuolumne Co., 8 July, 1964, elev. 8,000 ft. (R. P. Allen); 2 ♂, Strawberry, Tuolumne Co., 19 and 20 June, 1957 (A. E. Pritchard); 1 ♂, same locality and collector, 3 July 1957.

The holotype is deposited in the type collection, Department of Entomology and Acarology, University of California, Davis. Paratypes are deposited in the following institutions and collections: American Museum of Natural History, New York; Bauer-Buckett collection, Davis; California Academy of Sciences, San Francisco; California Insect Survey, University of California, Berkeley; California State Department of Agriculture, Sacramento; John G. Franclemont collection, Cornell University, Ithaca, New York; Los Angeles County Museum of Natural History, Los Angeles; United States National Museum, Washington, D. C.; University of California, Davis.

Anepia plumasata can readily be distinguished from *amabilis* both by genitalia and by maculation. *A. plumasata* is darker in general coloration than is *amabilis*; the median area of the primaries is darker and the claviform longer than in *amabilis* as well as the ordinary cross lines being more obscured in the former; the secondaries are dorsally darker in *plumasata*. Both the male and female genitalia of *plumasata* are larger than in *amabilis* (as can be seen in the illustrations); the aedeagus of *plumasata* possesses more lobes in the vesical sac than does *amabilis*; the heavily sclerotized structure protruding over the costa of the valve is smaller in *plumasata* than it is in *amabilis*.

The genitalic illustrations were prepared by the first author with aid of a bioscope, corrections being made by use of a dissecting microscope.

We wish to extend our appreciation to all those who made material available for this project, and to Ronald C. Gardner for his assistance in preparation of the manuscript.

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THE EFFECTS OF VITAMINS ON THE DEVELOPMENT OF *NYMPHALIS ANTIOPA* (NYMPHALIDAE).

G. Rácz
V. Petofi, S. U. 11, Budapest, Hungary

In the past there have been many papers reporting the effects of freezing, heating, or chemical treatment on the development of Lepidoptera. Most of these papers have stressed the phenotypic changes, if any, which were produced. The increased production of melanin in individuals of many species when their pupae are subjected to near-freezing temperatures is a well known phenomenon.

I have experimented with the effects of cold temperature myself. Immediately after ecdysis, pupae of *Zerynthia hypermnestra* Sc. were subjected to a temperature of –10° C for 30 minutes, followed by an hour at 18° C, and another 30 minutes at –10° C. The resulting imagos were characterized by an abnormally extensive black pattern.

A colleague in Hungary, L. Bezsilla, produced a series of *Nymphalis antiopa* (L.) aberration hygiae by injection of a solution of phosphomolybdic acid into the pupae. This experiment also produced a marked shortening of the pupal period.

The above experiment gave me the idea of treating larvae or pupae with solutions of purified vitamins. I attempted two types of experiments, the first of which I describe below.

On June 22, 1958, ten groups of five three-day old *Nymphalis antiopa* larvae were fed *Salix* leaves upon which the following vitamin solutions had been brushed: 1) Vitamin C; 2) Vitamin B_1; 3) Vitamin B_{12}; 4) Vitamin B_1 and B_{12}; 5) Vitamin B_1 and C; 6) Vitamin B_{12} and C; 7) Vitamin B_1, B_{12}, and C; 8) Vitamin D_2; 9) Vitamin A and D_2; 10) Control.

In the groups with combinations of vitamins, one was brushed on the leaves after the previous one had been applied.

By June 24 conspicuous size differences were noticeable in several groups. On July 1, some caterpillars died displaying symptoms similar to those produced by virus disease, *i.e.* the internal portions of the body became liquified. Among those that died were those treated with oily vitamins (A and D_2). The larvae fed leaves treated with oily vitamins had hardly fed, and had not increased in size very perceptibly.

On July 3, the larvae of group six (B_{12} and C) had pupated, and all of the larvae of group one (C) had pupated by July 6. On July 6, the controls had only reached the half way point in their development, and none had pupated until July 13.

The first adult emerged on July 9, and was produced from a group six (B_{12} and C) pupa. The first adult from the control group emerged on July 25. The total emergence of the different groups was as follows:

GROUP NUMBER	VITAMINS	NUMBER OF ADULTS
1	C	4
2	B_1	2
3	B_{12}	3
4	B_1, B_{12}	3
5	B_1, C	3
6	B_{12}, C	5
7	B_1, B_{12}, C	4
8	D_2	0
9	A, D_2	0
10	Control	4

It is remarkable that the larval and pupal stages of the larvae fed extra vitamins, especially group six (B_{12} and C), were so strikingly shortened. The production of adults occurred within the range of 33 to 40 days from the start of the experiment for the control group and only 17 to 29 days for those groups which had been subjected to vitamin treatment.

A phenotypic change was also produced in the individuals which had received extra vitamins as larvae. In these adults the normally yellow border was almost completely black.

The second type of experimentation involved the direct injection of vitamin solutions into *N. antiopa* larvae. As the author was not properly equipped and thus, could not inject exact dosages, the results were inconclusive.

Injections of vitamins into pupae produced no noticeable effects.

ACKNOWLEDGMENTS

I wish to thank the Chinoin Factory, a pharmaceutical laboratory in Budapest, which graciously supplied me with the necessary vitamin preparations for the experiments reported in this paper.

REPORT ON A COLLECTION OF HESPERIIDAE FROM HONDURAS

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Introduction

Evans (1951, 1952, 1953, 1955) listed 223 species of Hesperiidae from Honduras, divided between the three subfamilies as follows: 9 Pyrrhopyginae, 136 Pyrginae and 78 Hesperiinae. Many species have been reported from the surrounding countries but not from Honduras, so the actual number of hesperiid species resident there may exceed 500. Honduran records have now been published for 275 species, many papers adding one or more to those listed by Evans, so that about half the expected number have been thus far reported. These figures alone do not indicate how poorly known Honduran butterflies are. Many of the records, especially the older ones, are based on single specimens bearing locality labels which read simply "Honduras" or "Spanish Honduras"; there are relatively few specimens available with adequate data and fewer still with ecological information. From the standpoint of biological knowledge, Honduras is one of the least known Central American republics.

The present collection was made chiefly by Monroe in 1962 and contains representatives of eighty-three species, many of which are new records from Honduras (indicated by an asterisk (*)). The Papilionoidea are being reported separately (Monroe, Ross and Williams, 1967), and the collection sites are discussed in that paper. Most of the hesperiids were taken at El Jaral, Cortés; this collection is substantially what one would expect to find on a Central American coffee *finca* in the tropical deciduous forest, where most of the specimens were taken.

The identifications were made by Miller, and the systematic notes are his responsibility; the specimens, unless otherwise indicated, are in the Monroe collection.

Systematic Account

The list which follows is arranged according to the sequence of genera given by Evans (1951, 1952, 1953, 1955). Reference will not be made to Honduran species listed in these works, but those species not recorded by him will be discussed in some detail, as will a few whose systematic position is in doubt.

PYRRHOPYGINAE

Jemadia hospita pseudognetus (Mabille). 1♂: El Jaral, Cortés; 14.viii. This species has been reported previously (as *hospita*) from Honduras (Bell, 1934).

PYRGINAE

Epargyreus exadeus complex. 2♂: El Jaral, Cortés; 11, 13.viii. The species in this group are poorly understood and are presently being examined by Miller. It seems better to avoid the use of specific names at this time. Evans (1952) records *E. s. spina* Evans and *E. clavicornis gaumeri* Godman from Honduras, the latter having been described from Ruatan Island.

Chioides catillus albofasciata (Hewitson). 1♂: El Jaral, Cortés; 13.viii.

Chioides catillus albius Evans. 1♂: Tela, Atlántida; 18.viii. This specimen represents the first Honduran record of this "subspecies" which was known previously from Costa Rica and Panama. The zone of overlap of *albius* and *albofasciata* now extends at least from Honduras to northern Panama thereby casting further doubt on the "subspecies" of the *catillus* complex.

Typhedanus undulatus (Hewitson). 1♀: El Jaral, Cortés; 14.viii.

Polythrix asine (Hewitson). 1♂: El Jaral, Cortés; 25.viii.

Codatractus a. alcaeus (Hewitson). 1♀: El Jaral, Cortés; 29.viii.

Urbanus p. proteus (Linnaeus). 2♂ 4♀: El Jaral, Cortés; 9–14.viii and 23.ix (one pair in Carnegie Museum).

Urbanus viterboana (Ehrmann). 2♂: El Jaral, Cortés; 8, 13.viii (one in Carnegie Museum). Evans (1952) described the "subspecies" *alva* and listed a pair from Honduras, but he did not record true *viterboana* from our area. There is broad overlap in the ranges of *alva* and *viterboana*, and they certainly cannot represent subspecies. Much more work remains to be done on the *proteus* complex before definitive statements can be made concerning species limits. For convenience we have here recorded the specimens as they run through Evans' key.

Urbanus d. dorantes (Stoll). 5♂: El Jaral, Cortés; 6, 14, 25.viii (two in Carnegie Museum).

Urbanus teleus (Hübner). 2♂ 1♀: El Jaral, Cortés; 9, 12.viii and 23.ix (one ♂ in Carnegie Museum).

Urbanus tanna Evans. 2♀: one from El Jaral, Cortés; 27.viii; and the other from Lancetilla, Atlántida; 7.vi.1961 (collected by Roger N. Williams).

Urbanus simplicius (Stoll). 4♂: El Jaral, Cortés; 9, 12, 14.viii (one in Carnegie Museum). The separation of this species and the next is well described by Tilden (1965).

Urbanus procne (Plötz). 1♂: El Jaral, Cortés; 23.ix.

Urbanus d. doryssus (Swainson). 1♂: El Jaral, Cortés; 13.viii.

**Astraptes alardus latia* Evans. 1♂: El Jaral, Cortés; 9.viii. This appears to be the first record of this handsome skipper from Honduras, but its occurrence there is not surprising; Evans (1952) and Williams (1927) list specimens from Guatemala, Nicaragua, Costa Rica, etc.

Astraptes anaphus annetta Evans. 2♀: El Jaral, Cortés; 9, 27.viii (one in Carnegie Museum).

Autochton longipennis (Plötz). 1♂: El Jaral, Cortés; 8.viii.

Autochton zarex (Hübner). 2♂ 1♀: El Jaral, Cortés; 8.viii and 23.ix (one ♂ in Carnegie Museum).

Achalarus a. albociliatus (Mabille). 1♂: Tela, Atlántida; 18.viii.

Cabares p. potrillo (Lucas). 1♂: Potrerillos, Cortés; 10.viii.

Spathilepia clonius (Cramer). 2♂ 1♀: El Jaral, Cortés; 12.viii and 23.ix (one ♂ in Carnegie Museum).

**Cogia c. caicus* (Herrich-Schäffer). 1♂: El Jaral, Cortés; 23.ix. This specimen

represents a considerable southward extension of the known range. Previous records place this species no further south than Guatemala.

Cogia calchas (Herrics-Schäffer). 3♂ 2♀: 2♂ from El Jaral, Cortés; 12.viii and 23.ix; 1♂ from Potrerillos, Cortés; 29.viii; and 2♀ from Tela, Atlántida; 18.viii (one pair in Carnegie Museum).

**Nisoniades castolatus* (Hewitson). 1♂: El Jaral, Cortés; 27.viii. This skipper has been taken in Nicaragua (Evans, 1953).

**Nisoniades ephora* (Herrich-Schäffer). 1♂: Cortés (either El Jaral or Potrerillos); 10.viii. Described from Nicaragua, this species has been previously taken from all the countries surrounding Honduras.

Pellicia dimidiata Herrich-Schäffer. 1♂ 2♀: El Jaral, Cortés; 14.viii and 23.ix (one ♀ in Carnegie Museum). The female in the collection of Carnegie Museum has aberrant genitalia, the left side being only half as well developed as the right. Normally the female genitalia of *dimidiata* are symmetrical.

**Noctuana noctua bipuncta* (Plötz). 1♀: El Jaral, Cortés; 14.viii. Evans (1953) lists specimens from Guatemala and Nicaragua, so its occurrence within our limits was to be expected.

Noctuana stator (Godman and Salvin). 1♀: El Jaral, Cortés; 23.ix.

Bolla phylo pullata (Mabille). 2♂: El Jaral, Cortés; 9, 14.viii (one in Carnegie Museum).

Staphylus ascaphalus (Staudinger). 1♂: El Jaral, Cortés; 14.viii.

Ouleus fridericus salvina Evans. 4♂: El Jaral, Cortés; 9, 12, 21.viii (one in Carnegie Museum).

Quadrus cerealis (Stoll). 1♂: El Jaral, Cortés; 5.xi.

**Quadrus c. contubernalis* (Mabille). 5♂: El Jaral, Cortés; 5.xi (two in Carnegie Museum). This skipper has been recorded previously from Guatemala and Costa Rica (Evans, 1953).

**Quadrus l. lugubris* (Felder). 2♂ 3♀: El Jaral, Cortés; 9, 12, 14, 25, 27.viii (one pair in Carnegie Museum). Previous records of the nominate subspecies have been from Mexico, Guatemala, Nicaragua and Costa Rica, so we are not surprised at its capture in Honduras.

**Mylon lassia* (Hewitson). 1♀: El Jaral, Cortés; 8.viii. This skipper also occurs in Guatemala and Nicaragua (Evans, 1953).

Mylon menippus (Fabricius). 1♂ 1♀: El Jaral, Cortés; 13, 17.viii.

**Carrhenes c. canescens* (Felder). 4♂: El Jaral, Cortés; 9, 14, 27.viii and 4.ix (one in Carnegie Museum). There are published records from Guatemala, El Salvador and Nicaragua (Evans, 1953).

Xenophanes tryxus (Stoll). 1♀: El Jaral, Cortés; 12.viii.

Antigonus nearchus (Latreille). 3♂: one from El Jaral, Cortés; 17.ix; and two from Potrerillos, Cortés; 29.viii (one in Carnegie Museum).

Antigonus erosus Hübner. 7♂: one from El Jaral, Cortés; 17.ix; and six from Potrerillos, Cortés; 10, 29.viii (two in Carnegie Museum).

**Antigonus corrosus* (Mabille). 1♀: El Jaral, Cortés; 9.viii. Occurrence of *A. corrosus* in Honduras is not surprising since Evans (1953) lists material from Nicaragua, El Salvador and Guatemala.

**Zopyrion sandace* Godman and Salvin. 1♀: Potrerillos, Cortés; 11.viii. This is the first record from further south than Volcán Santa Maria, Guatemala.

Achylodes busirus heros (Ehrmann). 2♂ 1♀: El Jaral, Cortés; 12.viii and 2, 14.ix (one ♂ in Carnegie Museum).

Achylodes t. thraso (Jung). 1♂ 1♀: El Jaral, Cortés; 13.viii and 23.ix.

Timochares t. trifasciata (Hewitson). 1♀: El Jaral, Cortés; 13.viii.

Anastrus s. sempiternus Butler and Druce. 1♂ 1♀: El Jaral, Cortés; 12, 17.viii.

Ebrietas evanidas (Mabille). 1♂: El Jaral, Cortés; 13.viii.

Helias phalaenoides cama Evans. 2♂ 1♀: El Jaral, Cortés; 21, 27, 29.viii (one ♂ in Carnegie Museum).

**Theagenes albiplaga aegides* (Herrich-Schäffer). 1♂: El Jaral, Cortés; 21.viii. *T. a. aegides* has been reported from Guatemala, El Salvador and Costa Rica (Evans, 1953).

Pyrgus adepta (Plötz). 1♂: Tela, Atlántida; 18.viii.

Pyrgus o. oileus (Linnaeus). 6♂ 2♀: 5♂ 2♀ from El Jaral, Cortés; 6, 9, 12, 28.viii; and the other ♂ from Potrerillos, Cortés; 29.viii (two ♂, one ♀ in Carnegie Museum).

Heliopetes m. macaira Reakirt. 1♂ 1♀: Potrerillos, Cortés; 10.viii.

Heliopetes a. arsalte (Linnaeus). 2♂: one from Potrerillos, Cortés; 10.viii; the other from Tela, Atlántida; 18.viii.

Heliopetes alana Reakirt. 2♂: one from El Jaral, Cortés; 23.ix; the other from Lancetilla, Atlántida; 18.vi.1961 (R. N. Williams).

Hesperiinae

Zariaspes mys (Hübner). 1♀: El Jaral, Cortés; 21. viii.

Anthoptus epictetus (Fabricius). 2♂: El Jaral, Cortés; 21.viii (one in Carnegie Museum).

Corticea c. corticea (Plötz). 2♂ 3♀: 1♂ 3♀ from El Jaral, Cortés; 9, 13.viii and 23.ix; the other ♂ from Palmerola, 3 mi. SW of Choluteca, Choluteca; 28.ix (one pair in Carnegie Museum).

**Callimormus juventus* Scudder. 1♂ 1♀: El Jaral, Cortés; 9, 14.viii. This species is previously known from Guatemala and Costa Rica (Evans, 1955).

**Eprius v. veleda* (Godman). 1♂: El Jaral, Cortés; 14.viii. Evans (1955) mentions Guatemalan and Costa Rican specimens, so its residence in our area was expected.

Monca telata tyrtaeus (Plötz). 1♀: Lancetilla, Atlántida; 19.viii.

?*Nastra l. leucone* (Godman). 1♀: Tela, Atlántida; 18.viii. This specimen is provisionally placed. If the specimen is *leucone*, it is the first record from Honduras. Evans (1955) lists specimens of the nominate subspecies from Mexico, Guatemala and Costa Rica, so its occurrence in our area is not unlikely.

Cymaenes odilia trebius (Mabille). 5♂ 1♀: El Jaral, Cortés; 9, 12, 14, 21.viii and 23.ix (two ♂ in Carnegie Museum).

Vehilius stictomenes illudens (Mabille). 4♂: El Jaral, Cortés; 14, 21, 29.viii and 23.ix (one in Carnegie Museum).

**Mnasitheus chrysophrys* (Mabille). 1♂: El Jaral, Cortés; 6.viii. Previous records include Guatemala and Costa Rica, and this very obscure little skipper is probably widely distributed throughout Central America.

Moeris remus (Fabricius). 1♂: El Jaral, Cortés; 12.viii.

**Parphorus s. storax* (Mabille). 1♀: El Jaral, Cortés; 9.viii. This is a common and widely distributed skipper.

**Vettius onaca* Evans. 2♂: El Jaral, Cortés; 12, 20.viii (one in Carnegie Museum). Evans (1955) proposed this name as a "subspecies" of *Vettius fantasos* (Stoll), but the two entities are sympatric. *V. fantasos* has been reported from our area, but *V. onaca* has not; the records of the latter are from Mexico, Guatemala and El Salvador.

Thoon modius (Mabille). 1♂: El Jaral, Cortés; 21.viii.

Eutychide complana (Herrich-Schäffer). 1♂ 1♀: El Jaral, Cortés; 9, 17.viii.

**Eutychide paria* (Plötz). 1♂ 1♀: El Jaral, Cortés; 13.viii and 23.ix. Evans (1955) does not list specimens further north than Costa Rica, so our material represents a considerable northward extension of the known range of *paria*.

**Naevolus o. orius* (Mabille). 1♀: El Jaral, Cortés; 14.viii.

Quinta cannae (Herrich-Schäffer). 2♂: El Jaral, Cortés; 9, 14.viii (one in Carnegie Museum).

**Cynea cynea* (Hewitson). 1♂: El Jaral, Cortés; 23.ix. Evans (1955) records it from all the countries surrounding Honduras.

Conga chydaea (Butler). 2♂: El Jaral, Cortés; 17, 23.ix (one in Carnegie Museum).

Hylephila p. phyleus (Drury). 1♂: Potrerillos, Cortés; 11.viii.

Pompeius pompeius (Latreille). 3♂ 1♀: El Jaral, Cortés; 12, 13, 21.viii (one ♂ in Carnegie Museum).

**Mellana helva* (Möschler). 1♂: El Jaral, Cortés; 23.ix. The specimen of this rare species has been deposited in Carnegie Museum.

Calpodes ethlius (Stoll). 1♂ 1♀: the ♀ from Potrerillos, Cortés; 10.viii; and the ♂ from the San José sugarmill, San Pedro Sula, Cortés; 28.viii.1961 (R. N. Williams; *ex larva* on *Canna*).

Panoquina s. sylvicola (Herrich-Schäffer). 1♂ 2♀: El Jaral, Cortés; 21.viii and 23.ix (one ♀ in Carnegie Museum).

Panoquina evadnes (Stoll). 2♀: El Jaral, Cortés; 21.viii and 23.ix (one in Carnegie Museum).

Niconiades xanthaphes Hübner. 1♀: El Jaral, Cortés; 13.viii.

**Niconiades viridis vista* Evans. 1♀: El Jaral, Cortés; 12.viii. This subspecies previously has been recorded from Nicaragua (Evans, 1955).

**Saliana esperi* Evans. 1♂: El Jaral, Cortés; 9.viii.

Unidentified Specimens

In addition to those specimens reported above, three others (a ♂ without the abdomen and two ♀) could not be identified. These skippers are all Hesperiinae and are referable to Evans' (1955) "Group J."

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AN ABERRANT *HELICONIUS CHARITONIUS* (NYMPHALIDAE)

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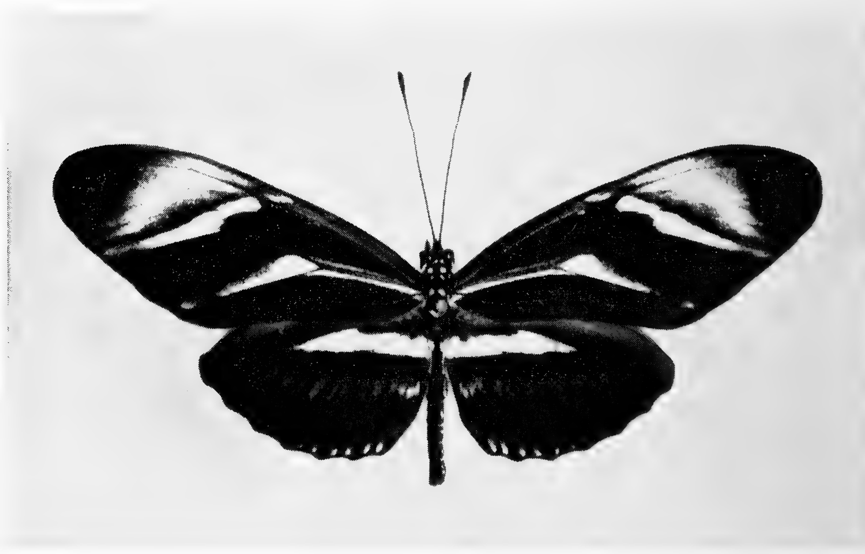
A pupa found on 24 October 1966 at San Antonio, Texas, produced the aberrant female *Heliconius charitonius vasquezae* (Comstock & Brown) illustrated. As can be seen in the illustration, the yellow sub-apical band on the forewing is blurred into a sub-apical patch. The remaining yellow bands are reduced somewhat, and the postmedian spot-band on the hindwing is nearly absent. These markings are reproduced on the ventral side. The insect emerged 28 October after being brought to Houston. There was no important temperature change involved in the change in locality, nor had there been any major temperature change in San Antonio in the preceding weeks.



ACKNOWLEDGMENT

I wish to express my deepest thanks to Mr. Andre Blanchard of Houston for taking time from his work on the microlepidoptera to photograph the specimen for me.

STRUCTURES EMPLOYED BY *ACTIAS LUNA* (SATURNIIDAE) IN EFFECTING EMERGENCE FROM THE COCOON

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Moths emerging from pupae confined within tough fibrous cocoons have evolved a number of methods to effect a safe exit. In the Saturniidae the polyphemus moth exudes copious quantities of an acidic fluid which softens and dissolves the silken filaments. The cecropia larva constructs its double-walled cocoon with a narrow crimped phalanx which effectively compensates for the smaller amount of fluid secreted by the adult. Observation of a number of emerging moths in the spring of 1966 revealed an unusual method employed by the *Actias luna* imago.

Emergence of the luna moth is a relatively noisy process, periods of activity being accompanied by rythmic scratching sounds clearly audible at a distance of 20 feet or more in a quiet room. Although the cocoon is extremely tough, the walls are thin and, with good lighting conditions, it is possible to obtain a reasonably distinct view of the contents. It was noted that the head, thorax and wings of the insects were freed from the pupal case prior to the assault on the cocoon and that the scratching sounds appeared to coincide with movements of the undeveloped wings which were alternately raised and lowered. During periods of inactivity (when the wing movement and scratching ceased), the insects were observed to rotate slowly through twenty or thirty degrees, completing from three to five revolutions during the entire emergence sequence. Within five to ten minutes from the commencement of activity two small projections could be discerned apparently arising from the base of the wings and working in unison with them. Moving through a vertical arc of approximately 40–45° the projections seemed to be severing the cocoon filaments with an abrasive action. The final stages of emergence were obscured by the shedding of quantities of fluffy hair-like scales resulting from the pressure of the moth's thorax against the yielding threads.

On emergence the projections were no longer visible nor could they be discovered when the fore wing of a dead specimen was carefully examined. In order to determine the nature and location of the structures, a single specimen was allowed to proceed to the final stages of emergence. It was then placed in the freezer compartment of a household refrigerator where movement was arrested almost immediately.

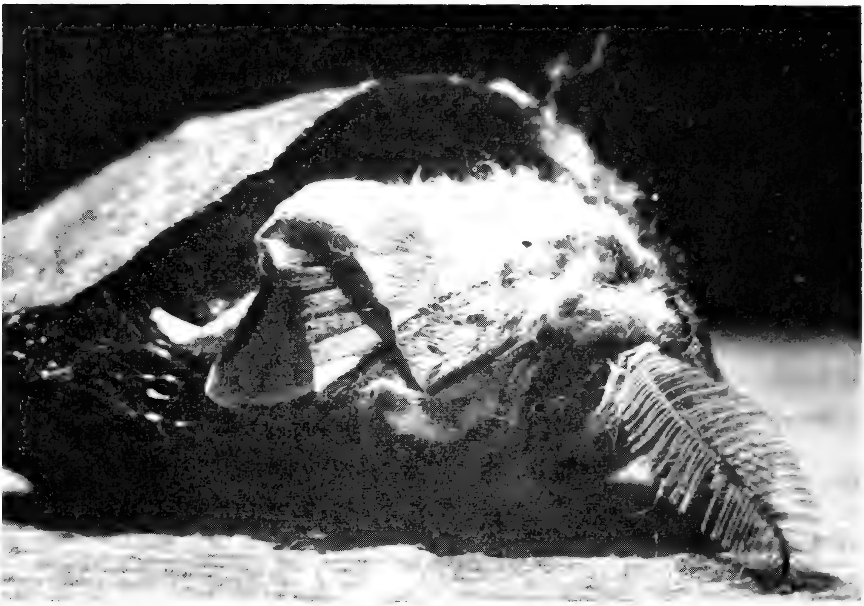

Fig. 1. Cut away cocoon showing *Actias luna* immediately prior to emergence, and the location of thoracic spur used to sever cocoon filaments.

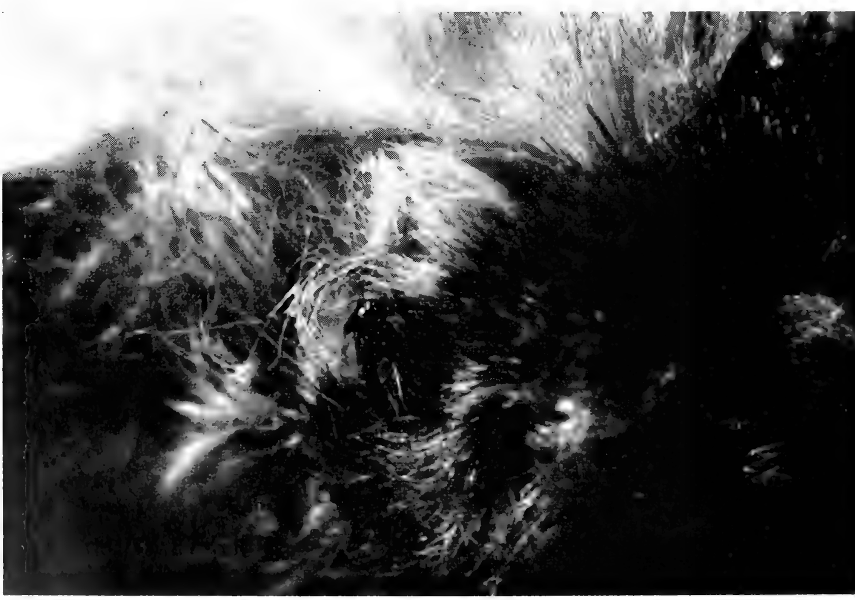

Fig. 2. A magnified view of thoracic spur in cutting position.

Fig. 3. A magnified view of thoracic spur on fully developed *Actias luna* from which scales have been removed.

Fig. 4. *Actias luna* moth.

After 24 hours the cocoon was removed and one side was carefully cut away with a razor blade exposing the moth within.

Under magnification the structures were observed to comprise extensions of the chitin from the mesothorax and to arise immediately above the junction of the wing from a broad base, tapering slightly towards the middle, and terminating in a thickened spear shaped point, dark brown in colour and highly polished. These projections I have termed "thoracic spurs." In a fully developed moth the "thoracic spurs" (no longer flexible) lie in a horizontal plane and are concealed by the scales of the thorax.

From the foregoing observations it would appear that the adult *Actias luna*, having emerged from the pupal case, employs a pair of "thoracic spurs" to sever the threads of the cocoon with an abrasive cutting action.

NOTES ON LARVAL FOODPLANTS OF SOME SPHINGIDS IN ONTARIO, CANADA

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Since 1963 systematic rearing of caterpillars of sphingids and some other lepidopterous families has been carried out during the summer by the Department of Entomology, Royal Ontario Museum, University of Toronto. In 1963, 1964 and 1966 this was done by our summer field party at the Biological Station of Queen's University, Kingston, Ontario, near Chaffeys Locks, Ontario. In the course of the rearing program it was found that certain species either prefer foodplants other than those recorded in the literature or refuse those which are commonly thought to be preferred. When we take as a guideline the foodplant records of Forbes (1948), Ferguson (1954), and McGugan (1958), then we find the following accord or discord.

Ceratomia amyntor (Huebner). It is commonly thought that this sphingid feeds on elm. Forbes and Ferguson list only "elm". We knew from amateur collectors in Toronto that for some years they used to look for *amyntor* caterpillars on basswood, in addition to elm. Also McGugan has basswood as foodplant in two cases of nineteen. We reared the species in 1966 successfully on basswood. In Chaffeys Locks caterpillars of *amyntor* were found on basswood.

Sphinx gordius Cramer. Forbes lists apple, ash and wax-myrtle, Ferguson blueberry, *Comptonia* and *Myrica* as foodplants. Apple and ash, however, were refused by our caterpillars in 1964. They took only

Myrica gale in Chaffeys Locks. The same was true for caterpillars which we had in 1965 from Algonquin Park, Ontario. We also tried tamarack, the foodplant which McGugan gives as the main foodplant, but the caterpillar only nibbled on it for a few days and then died. It was, however, possible to change the almost grown up caterpillars from *Myrica* to the common blueberry (*Vaccinium* sp.).

Cressonia juglandis robinsonii Butler. In 1963 we had many eggs of this species which hatched. The caterpillars, however, refused walnut and hickory completely; they accepted *Ostrya* instead. This plant, which is mentioned a few times in older literature, but not in Forbes (who lists only walnut and hickory) or Ferguson who says nothing definitive about the foodplant. Ferguson does mention that he found a Sphingid caterpillar on introduced copper beech which was probably *juglandis* but failed to yield an adult. In 1964 we found one caterpillar on *Carya cordiformis*. The caterpillars we had from eggs, however, again preferred *Ostrya* and took only small bits from *Carya* leaves offered together with the *Ostrya* leaves. The same was repeated in 1966. As the species, however, occurs quite frequently in localities where no *Ostrya* is available, we used our caterpillars in 1966 for some experiments with nearly related foodplants. We gave them *Carpinus*, *Corylus*, *Alnus* and *Fagus* all of which they eat without any discrimination; however, they refused the related *Betula*. The fact that *juglandis* feeds on this great variety of trees and shrubs, all belonging to the order Fagales, in addition to the Juglandales, may account for its occurrence around Lake Nipigon and in places like Sudbury, Ontario, where only *Corylus* and *Alnus* would readily be available.

Smerinthus jamaicensis Drury. Forbes states that wild cherry is the preferred host, which Ferguson lists together with birch, poplar and willow. In 1966 our caterpillars refused cherry and settled down only after we gave them *Salix* (any species of *Salix*). On this food they soon began to thrive. Later we switched them to a hybrid poplar and it seems that this plant was preferred over willow. Toronto collectors say that they look only on willow to find *S. jamaicensis* caterpillars.

Paonias excaecata (J. E. Smith). Here is another apparent disagreement to Forbes who lists "wild cherry". In 1966 our caterpillars were first given only wild cherry, which, after some hesitation, they began to accept. As we knew that in this area they feed on basswood, we added basswood and the caterpillars switched from cherry to basswood. At Chaffeys Locks we found eggs of *excaecata* on basswood leaves. These eggs hatched in due course. Ferguson says of this species: "probably

a rather general feeder on deciduous trees," and McGugan has white birch as the preferred foodplant.

Paonias myops (J. E. Smith). In 1965 we reared this species without difficulty on *Prunus pensylvanicus.* Forbes lists "wild cherry and other Rosaceae"; while Ferguson lists "probably" *Prunus virginiana* and *Prunus serotina,* and McGugan lists *Amelanchier.*

Pachysphinx modesta (Harris). In 1964 we reared this species on *Populus tremuloides.* In 1966, we found one full grown caterpillar on the same tree. Forbes lists "poplar and willow," Ferguson lists "aspen," and McGugan list "aspen," yellow birch, and willow in order of preference.

Celerio gallii intermedia Kirby. In 1966 we obtained three eggs from a female caught at light in Geraldton, Ontario. These eggs, which were laid on *Epilobium angustifolium,* produced pupae in only 24 days. One adult male emerged 17 days after pupation. This indicates a partial second generation, which was, as far as I know, previously unknown. The eclosed pupa resulted from a brown caterpillar, while two female pupae from black ones hatched the following spring. In 1967 we reared this species successfully on grapevine.

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Addendum to Mites from Noctuid Moths

Too late for inclusion in my paper on mites from noctuid moths (Jour. Lepidopterists' Society 21 (3): 169–179), I learned of a publication by G. L. van Eyndhoven (1964) in which are cited a number of records of the occurrence of the cheyletid mite *Cheletomorpha lepidopterorum* on moths of various species including several noctuids. Van Eyndhoven's paper is entitled "*Cheletomorpha lepidopterorum* (Shaw, 1794) (= *Ch. venustissima*) (Acari, Cheyletidae) on Lepidoptera." It appears as No. 136 of Volume 11 in *Beaufortia, Series of Miscellaneous Publications, Zoological Museum—Amsterdam,* pages 53–60 (December 17, 1964). The mites are said to attach themselves to the wings of their hosts. Van Eyndhoven regards the association as phoretic rather than parasitic.

Figures 2 and 3 in my paper were rotated 90° clockwise from their intended positions. Thus the explanations should be corrected as follows: in fig. 2, the pale antler-like cuticular outgrowths of the nodular sclerite appear just below the center of the photo; in fig. 3, the upraised hindwing appears at the upper left, and the base of the abdomen at the bottom of the photo.

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THE EFFECTS OF PHOTOPERIOD ON THE INITIATION OF PUPAL DIAPAUSE IN THE WILD SILKWORM, *ACTIAS LUNA*

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During 1950 and 1951, Tanaka published a series of five papers (reviewed by Lees (1955) and Williams & Adkisson (1964)) demonstrating that photoperiod affects the initiation of diapause in the silkworm, *Antheraea pernyi* Guérin-Méneville. Since I found no literature as to whether photoperiod also affects the larvae of *Actias luna* (Linnaeus), the following experiment was carried out.

A total of 51 *A. luna* ova from Des Moines, Iowa, was obtained from Mr. Duke Downey. The first 13 hatched on June 6, 1966, 22 more hatched on June 7, and by June 8, a total of 40 had hatched. On that date, the larvae were divided among four fish tanks and exposed to 0, 11, 16, or 24 hours of illumination each day. Twelve larvae were put into each of the containers exposed to 11 and 16 hours of light, 8 each were put into the tank exposed to continuous light and the tank exposed to continuous darkness. On June 9, 2 more larvae hatched. One was put in the container with the 16 hour photoperiod, the other in the container exposed to continuous light.

All larvae were fed washed bitternut hickory leaves, stems of which were put through holes in the tops of plastic boxes containing water. The tanks were covered with mosquito netting and kept indoors at a temperature which varied from about 20°C to 30°C. The tanks were cleaned and the larvae were fed at frequent intervals. Each tank received about 50 foot candles of illumination from two 40 watt GE F400W fluorescent cool white lamps hung about four feet above the containers. The 11- and 16-hour photoperiod containers were covered with cardboard boxes at 6:00 P.M. and 11:00 P.M., respectively, and uncovered each morning at 7:00 A.M. The container with continuous darkness was kept covered except for 5-10 minutes each day for observation and feeding purposes.

Richter (1966) and Seeley (1963) state that *A. luna* larvae take 48–50 days from hatching to spinning. My individuals began spinning cocoons after an average of 27 days, and some after no more than 25 days following hatching of the eggs. (Table I). Those exposed to the 16 hour photoperiod took the shortest time, those exposed to the 11 hour photoperiod were second, those in complete illumination were third, and those in complete darkness took the longest time.

After 14 days, each cocoon was put in a container exposed to an 11

TABLE I. DATES OF COMMENCEMENT OF COCOON CONSTRUCTION (LARVAE BEGAN FEEDING JUNE 6–9).

Photoperiod	July 1	2	3	4	5	6	7	8	9	Total
24 hrs	0	2	2	0	0	2	0	0	1	7
16 hrs	4	2	3	0	1	0	0	0	0	10
11 hrs	0	1	3	5	2	0	0	0	0	11
00 hrs	0	0	0	2	0	1	2	2	0	7

hour photoperiod. It was felt that after 14 days, diapause or non-diapause would have been decided and these conditions would allow non-diapause pupae to emerge while preventing the termination of diapause in the others.

As summarized in Table III, all individuals that had been exposed to the 16 hour photoperiod emerged as adult moths within 15–21 days after the spinning date. Those whose larvae had been exposed to continuous illumination emerged from their cocoons in 17–25 days. It was concluded that both of these photoperiods successfully prevent the onset of pupal diapause. By contrast, none of those whose larvae were reared under the 11 hour photoperiod had emerged five months after spinning. All these pupae appear to be in diapause. Of the seven individuals reared in continuous darkness, the first two to spin emerged as adults in 17 days. The other five have not emerged and appear to be in diapause. The data are reported in Tables II and III.

A number of other interesting observations were made:

(1) Collins and Weast (1961) stated that *A. luna* larvae become reddish-brown immediately before spinning. In this experiment, I observed red larvae only in the 11 hour photoperiod, in which all of the pupae entered diapause. Since no red larvae and a number of green spinning larvae were observed in the tanks receiving 16 and 24 hours of illumination, it appears that the larvae turn red only when they are destined to enter diapause as pupae.

TABLE II. SURVIVAL RATE OF LARVAE AND NUMBER OF DIAPAUSING COCOONS

Photoperiod	Original Number	Number Spinning	Survival %	Number in Diapause	% in Diapause
24 hrs	9	7	78	0	0
16 hrs	13	10	77	0	0
11 hrs	12	11	92	11	100
0 hrs	8	7	88	5	71

TABLE III. PERIOD OF DEVELOPMENT OF NON-DIAPAUSE PUPAE

Complete Light		16 Hr Photoperiod		Complete Darkness	
Date Spun	Days to Hatch	Date Spun	Days to Hatch	Date Spun	Days to Hatch
July 1	19	July 1	16, 17, 18, 18	July 4	17, 17
2	20	2	19, 21		
3	19, 25	3	15, 18, 19		
6	18, 19	5	17		
9	20				
Average	20	Average	18	Average	17

(2) Collins and Weast also state that single brooded cocoons are always brown in color and are usually spun on or near the ground. By contrast, non-diapausing cocoons that emerge in late summer are nearly white and are spun in the leaves. In agreement with Collins and Weast, those cocoons from the 16 and 24 hour photoperiod containers were light colored and were spun mostly among the leaves. As mentioned above, all these developed without diapause. Those from the 11 hour photoperiod were brown and most were spun attached to the fish tank or water container. All these were diapausing pupae. Those given complete darkness were all brown, but most were spun on the leaves.

(3) In the container exposed to complete darkness, the red spots that appeared in the second, third, fourth and fifth instars in the *A. luna* larvae in the other containers, were not present until the fifth instar. Instead, they were a yellowish color in the early stages.

(4) One double cocoon was spun, containing two pupae and no partition between them.

SUMMARY

Tanaka discovered that *Antheraea pernyi* larvae develop without pupal diapause when they are reared under day-lengths longer than 14 hours (early summer), but transform into diapausing pupae when reared under day-lengths of less than 14 hours (late summer and autumn). My experiments show that *Actias luna* larvae also develop without pupal diapause when reared under long day-lengths (16–24 hours), but go into diapause when reared under short day-lengths (11 hours). Tanaka also showed that only 2% of the *A. pernyi* larvae kept in continuous darkness developed into diapause pupae. In my experiment, 71% of the *A. luna* in continuous darkness went into diapause.

ACKNOWLEDGMENT

I would like to express my thanks to Dr. Carroll M. Williams, Bussey

Professor of Biology, Harvard University, for his encouragement and for reviewing this manuscript.

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OBSERVATIONS ON *ŒNEIS MACOUNII* (SATYRIDAE) IN MANITOBA AND MINNESOTA

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Referring to the popular reference works, little can be ascertained concerning the bionomics of *Œneis macounii* Edwards. Klots (1951) suggests that it favors grassy Canadian Zone meadows, perhaps wet or boggy ones; Ehrlich & Ehrlich (1961) refer to a northwestward range from northern Michigan and Minnesota; Holland (1931) indicates two localities, Lake Superior's north shore and the eastern base of the Rockies in Alberta; Macy & Shepard (1941) observe that it is found in wooded grasslands near the Nipigon River in Ontario.

It is thought that the field observations of the present authors will increase the published information concerning this species, especially since these observations are somewhat contrary to those previously recorded. Series of *macounii* were collected at widely separated points on June 26, 1966; 13 ♂♂ and 15 ♀♀ by Masters and Sorensen in Sandilands Provincial Forest, eight miles southeast of Richer in southeast Manitoba; 4 ♂♂ and 2 ♀♀ by Conway in the vicinity of McNair, Lake County, Minnesota.

The Sandilands colony was located with the help of C. S. Quelch, who knew of it from previous collecting. The locality is a large open jack pine forest near an acid bog. The two sexes possessed different types of flight behavior and habits. The sex of an individual in flight could be determined from a distance even though the sexes are nearly identical in macu-

lation. Females flew slowly without apparent direction through the pine forest and were readily netted. Males were more active fliers and much more difficult to capture. Males generally perched on leaves that gave them an observation point over small clearings. From this vantage point, they would fly at other male *macounii* coming into view. Sometimes other species or even a net stimulated flights. Several males were captured from their perches and an hour or two later were replaced by new males, often on the same perches. The jack pine forest was extensive, but the males seemed to be concentrated on its southern edge near a gravel road, which was perhaps the highest land in the area.

Both sexes seemed to land in sunlit spots with wings open, only infrequently would one close its wings. One female lit at a wet spot in the road and closed her wings without showing an inclination to orient with the sun. Several large fields nearby yielded only one worn male *macounii*.

In Minnesota, *macounii* had been expected in the large open field that borders the McNair Waystation, where Huber (1965) reported finding them in 1964. The two specimens he caught were sitting on rocks with wings closed and inclined toward the sun to cast very little shadow. *O. macounii* was not found in the field but six were netted and others seen in nearby jack pine forests. A few small acid bogs as well as pine forests surround the field at McNair. *O. macounii* males "patrolled" sunlit openings and small clearings in the forests. They lit with open wings on small bushes and were wary.

The Minnesota specimens were fresh; those from farther north in Manitoba rather worn. However, northeast Minnesota was experiencing an unusually late spring.

Guppy (1962) made observation of *Œneis nevadensis* Felder on Vancouver Island. He indicates that male *O. nevadensis* are usually collected in clearings along the tops of ridges and that these clearings probably serve as a rendezvous for mating. A male established its territory on a hilltop and displaced other males while waiting for a female. Females were presumed to fly to the hilltops to mate, then disperse to other areas for egg laying. Guppy's "hilltopping" theory explains the habits of the males and the relative scarcity of females. The phenomenon is very likely similar with *Œneis macounii*. Because *O. macounii* occurs in less rugged terrain the rendezvous spots are not greatly removed from the general habitat and the observed scarcity of females isn't as great.

Previous *Œneis macounii* records for the United States consist of many records from Isle Royal, Michigan and only three captures in Minnesota. Many colonies might exist between Ely and Two Harbors in northeast Minnesota, Bayfield county in Wisconsin, the northern fringes of Michigan and the Turtle Mountains of North Dakota. Collectors are urged to

look for it during mid to late June in open jack pine forests. Like *nevadensis* in the west, *macounii* has a two-year life cycle and is found in even numbered years. However, some colonies (*i.e.* Riding Mountains) are on odd numbered year cycles. It is likely that Huber's specimens and some of the other early records were strays from more favorable environments into grassy areas.

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—(J.H.M.) 121 Birch, Mahtomedi, (J.T.S.) 5309 - 37th Ave. S., Minneapolis, (P.J.C.) 3114 Pillsbury Ave., Minneapolis, Minnesota.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE
A.(n.s.)79

ANNOUNCEMENT

Required six-month's notice is given on the possible use of plenary powers by the International Commission on Zoological Nomenclature in connection with the following names listed by case number:

(see, *Bull. zool. Nomencl.* 24, pt. 2, 27 April 1967):

1786. Type-species for *Crioceris* Müller, 1764, and *Lema* Fabricius, 1798 (Insecta, Coleoptera)
1788. Type-species for *Cryphalus* Erichson, 1836 (Insecta, Coleoptera)

(see, *Bull. zool. Nomencl.* 24, pt. 3, 30 June 1967):

1761. Suppression of *Gryllus succinctus* Linnaeus, 1758; *Acridium assectator* Fischer von Waldheim, 1833; *Cyrtacantharis fusilinea* Walker, 1870; *Cyrtacantharis inficita* Walker, 1870; *Acridium rubescens* Walker, 1870; *Acridium elongatum* Walker, 1870 (Insecta, Orthoptera)
1732. Type-species for *Elatophilus* Reuter, 1884 (Insecta, Hemiptera)
1791. Validation of two species named *Papilio aglaja* Linnaeus, 1758 (Insecta, Lepidoptera)

(see, *Bull. zool. Nomencl.* 24, pt. 4, 20 September 1967):

1799. Suppression of *Phryganea maxima* Scopoli, 1763 (Insecta, Plecoptera)
1806. Suppression of *Charaxes jocaste* Butler, 1865 (Insecta, Lepidoptera)

Comments should be sent in duplicate, citing case number, to the Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W. 7, England. Those received early enough will be published in the *Bulletin of Zoological Nomenclature*.

W. E. CHINA, *Acting Secretary*

ENVIRONMENTAL VARIATIONS IN *EUPHYDRYAS ANICIA EURYTION* (NYMPHALIDAE)

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Anyone who has collected butterflies is aware that certain species vary greatly in appearance from one locality to another. In some cases, these variations are due to genetic differences in the populations, but in other cases, particularly where separate localities are encompassed by a small portion of a continuous range of the species, these variations may be caused by environmental conditions such as temperature and moisture. These environmental effects are particularly noticeable in Colorado, since many climatic conditions are found within relatively small areas of the State.

Of course, the best means to discover which variations are caused by particular environmental factors is to raise a single brood under different external conditions and then to compare the phenotypes of the adults. This method was tried with two species during the summers of 1958 and 1959, but none of the caterpillars matured, and conclusive results could not be obtained.

Thus, a less exacting method was employed: the analysis of a number of specimens from localities for which at least one environmental condition is precisely known. Use of this method does not eliminate the possibility that genetic constitution was selected by the particular environmental conditions. Nevertheless, the method can show by non-correlation that the environmental factors cannot be the cause of the variations. Therefore, the chief aim of this study is to determine if the interpretation of environmental conditions as a causal factor is consistent with actual variations in the butterfly species. In order to insure that correlations are legitimate, one must be careful to select a species that does not tend to wander, so that specimens captured at a particular place will be representative of specimens which mature under conditions associated with that location. Largely for this reason, the species chosen for this investigation is *Euphydryas anicia eurytion* (Mead), since another *Euphydryas* has been shown to be sedentary (Ehrlich, 1965). *E. a. eurytion* is common in the mountainous areas of Colorado.

Figure 1 shows the places from which each examined series was taken. All of these places are within a continuous range of the species. In order to minimize the possibility of inadequate sampling from a particular locality, only series with five or more specimens are used in

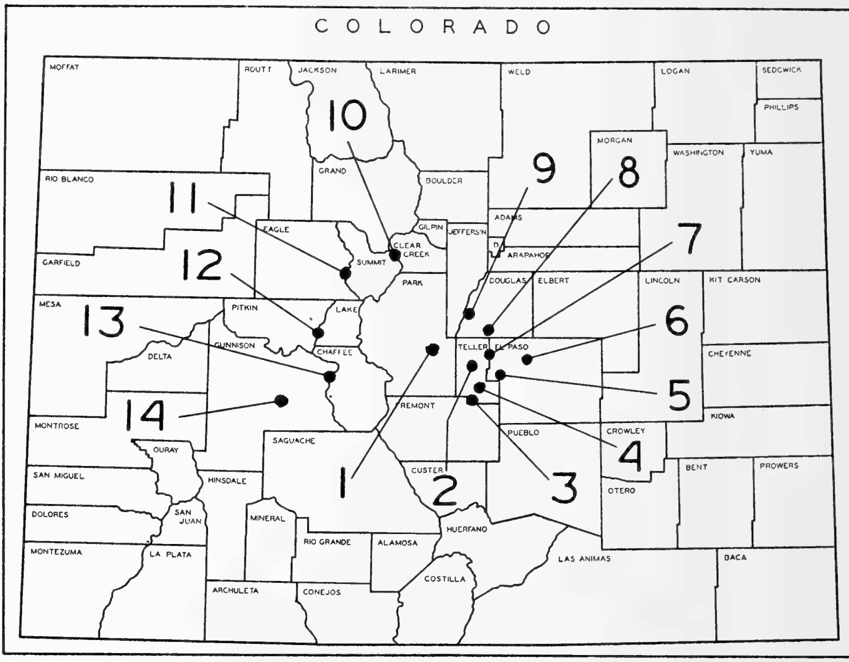

FIGURE 1

Map showing locations where the analyzed series were collected.
1. Wilkerson Pass, 2. Glen Cove, 3. Edlowe, 4. Seven Lakes, 5. Cheyenne Mountain, 6. Starr Ranch, 7. Rampart Range Road, 8. Mount Herman, 9. West Creek, 10. Loveland Pass, 11. Shrine Pass, 12. Independence Pass, 13. Cottonwood Pass, 14. Almont.

this study. Except where noted in the tables, specimens collected in different years from the same location are grouped together as one series.

The differing appearance of *eurytion* is due to variations in both size and coloring. Size was determined by measuring the radius of the right forewing with a vernier caliper, and these measurements were reproducible within 0.1 mm. When the size is correlated with the altitude of capture, the coefficient of correlation, r, is –0.66 for the males and –0.61 for the females. Tables I and II record both this correlation and the mean size of each series used. The relation between size and altitude is inverse, that is, as one factor (altitude) increases, the other factor (size) decreases. This relation is seen in Figures 2 and 3 which plot size as a function of altitude. The closer r is to 1.0 (its upper limit), the stronger the relation between the correlated factors (Brown, 1951). Taking into account the 11 degrees of freedom for the males, the probability, P, that

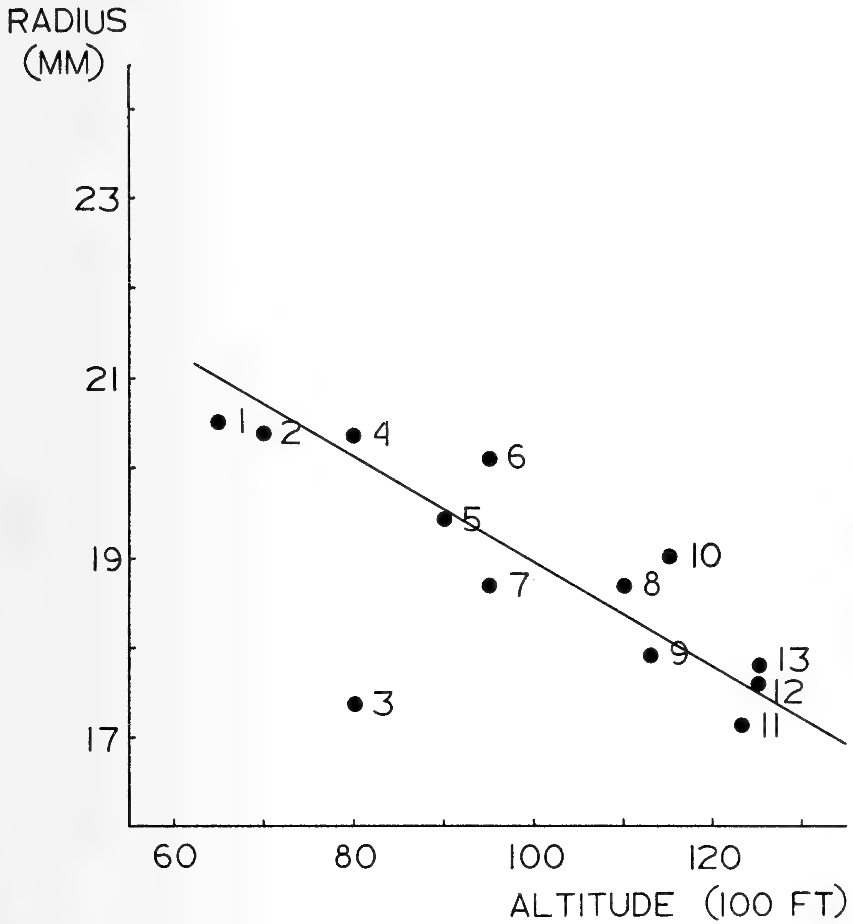

FIGURE 2

Graph showing the mean radius of the right forewing of the males as a function of altitude. The numbers refer to localities in Table I.

the relation is not real is less than 0.02 (Fischer, 1950). For the females, P is less than 0.1. At least for the males, one can confidently say that the relation is real. However, since the slopes of the curves in Figures 2 and 3 are the same within the limit of experimental error, one may confidently say that the relation is also real for the females.

The actual cause of the variation is not the altitude itself, but is some condition which varies proportionally to the altitude. The most likely suspect is the average temperature which in Colorado is inversely proportional to the altitude (Ramaley, 1927). For example, the series from

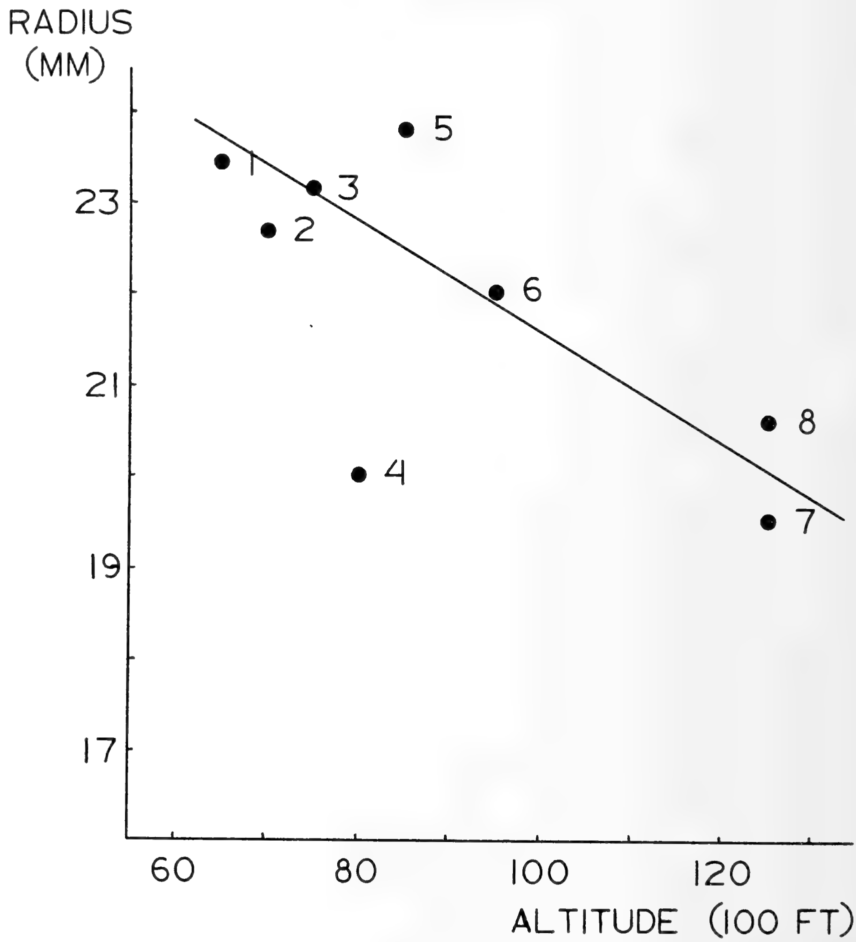

FIGURE 3

Graph showing the mean radius of the right forewing of the females as a function of altitude. The numbers refer to localities in Table II.

Almont which appears to fall outside the correlation can largely be explained if the differences in average temperature are the real causes for variation. Being on the western slope of the Continental Divide, Almont is generally considered to be colder for its altitude than the other series localities used, all of which are on the eastern slope (Climatological Data of Colorado, 1939). The observation of similar decreases in the size of *eurytion* specimens with an increase in northerly latitude tends further to indicate that temperature is an important contributing cause of these variations in size.

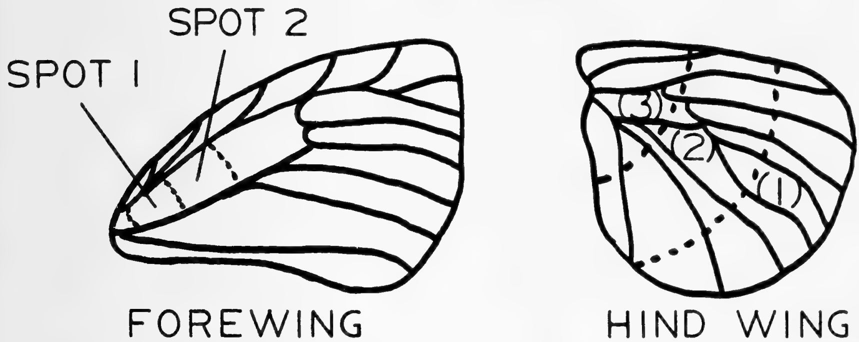

FIGURE 4

Diagram of wings showing the areas used to measure color differences (see Table III for the color code).

The change in moisture with altitude and hence its likelihood as another contributing cause is not clear, although some people believe that on the average, the greater the altitude in Colorado, the greater the average surface moisture of the ground. It appears to me that, at best, a consideration of moisture as a contributing cause of size variation would be inconclusive in this study.

In contrast to the correlation of size to altitude, the correlation of coloring to altitude depends upon rather qualitative measurements. One set of spots on the wings apparently changes from red-brown to yellow with an increase in altitude, whereas another set seems to change from red-brown to dark red-brown. In addition, the black overscaling of red-brown areas seems to increase with an altitude increase. Thus, the net effect is a change from a uniformly red-brown appearance to a contrasting checkerboard pattern. The raw data for color variation was collected for almost every area of both the forewing and the hindwing, but it is necessary to take only one representative spot from each set of variable spots for statistical analysis, since the spots within each set vary in exactly the same way. As seen in Figure 4, numbers corresponding to the colors of these spots and to the extent of overscaling were chosen so that the smaller numbers represent those conditions apparently present at higher altitudes. Thus, the sum of these numbers represents the entire apparent color change with altitude. All of these qualitative measurements were made by one person within a continuous period of eight weeks, so the interpretation of "red-brown" and other colors should be internally consistent. The measurement was qualitatively taken for the whole series rather than for each specimen, because series are quite

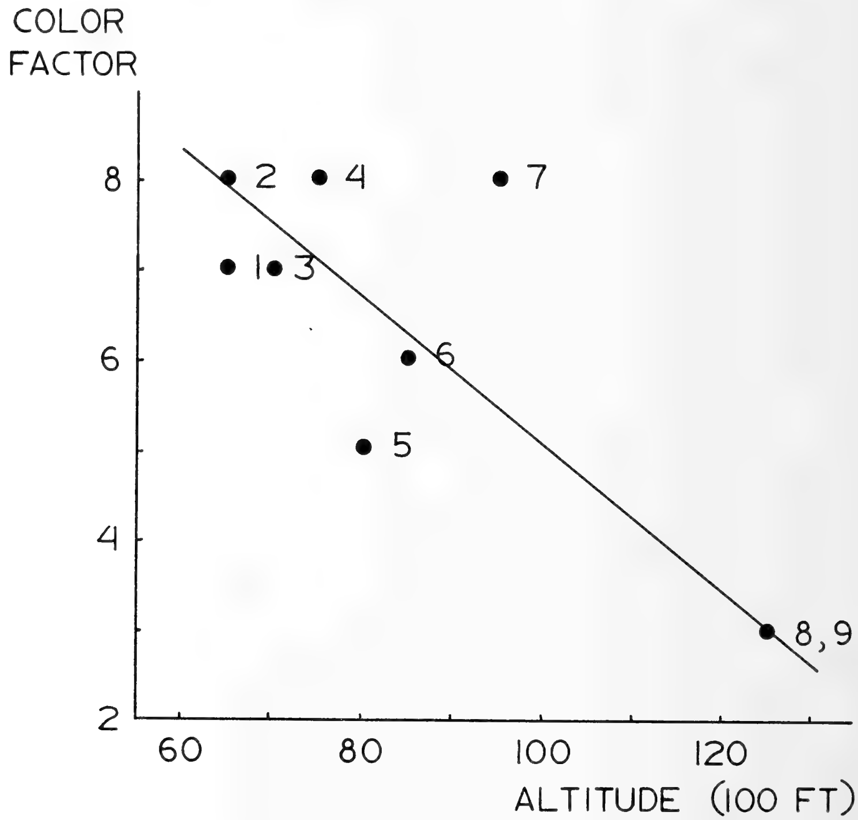

FIGURE 5

Graph showing the total color factor of the males as a function of altitude. The numbers refer to localities in Table IV.

uniform with respect to coloring, and subjective favoring of the color thesis was avoided by consciously deciding the doubtful cases in a manner least favorable to the hypothesis.

As seen in Table IV, all of the correlations for the males are significant to at least a 5% level. The certainty for the females is not quite so good; nevertheless, from Table V, we see that all but the spot 1 factor are significant to a 10% level. It is difficult to determine the actual cause of the variation, but temperature is a likely possibility: the Almont sample again follows the pattern associated with higher altitudes on the eastern slope. The apparent lack of correlation of the Wilkerson Pass sample may indicate that moisture is an important factor in coloring, for such an interpretation would explain both the Wilkerson Pass sample (the

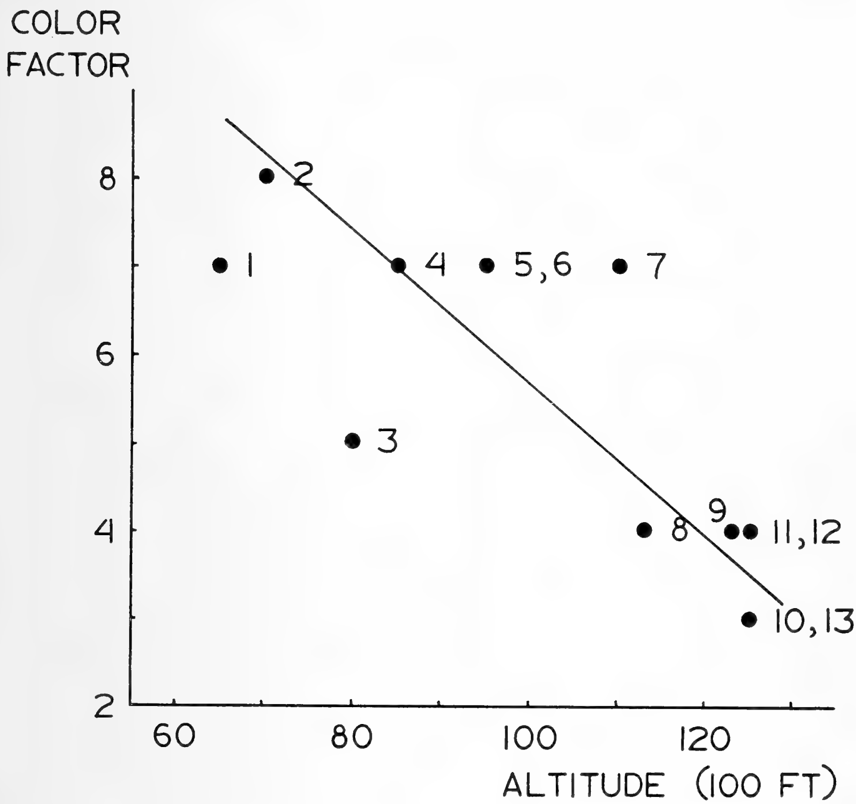

FIGURE 6

Graph showing the total color factor of the females as a function of altitude. The numbers refer to localities in Table V.

pass being abnormally dry for its altitude) and the Almont sample (Almont being abnormally wet) (Climatological Data of Colorado, 1939). However, such an interpretation must also assume that for the other samples, the moisture increases proportionally to the altitude. Since records are not available from all these areas and since the relation of moisture to altitude does not seem to follow so definite a pattern in Colorado as that for temperature, the contribution of moisture to these color variations must await further studies.

Thus, it is clear that variations in *Euphydryas anicia eurytion* within its Colorado range correlate with the altitude and hence to environmental conditions associated with the altitude—particularly the average temperature. Clearly a decrease in average temperature may affect the

TABLE I.—CORRELATION OF ALTITUDE WITH RADIUS OF RIGHT FOREWING-MALES

Series location	Altitude (100 ft)	N	Mean radius of series (mm)	σ
1. Starr Ranch	65	6	20.53	0.89
2. Cheyenne Mountain	70	9	20.38	1.24
3. Almont	80	6	17.35	0.65
4. West Creek	80	36	20.33	1.08
5. Edlowe	90	5	19.42	0.55
6. Rampart Range Road	95	29	20.11	0.95
7. Wilkerson Pass	95	8	18.68	0.33
8. Seven Lakes	110	6	19.17	0.72
9. Shrine Pass	113	9	17.89	0.62
10. Glen Cove	115	6	19.00	0.99
11. Loveland Pass	123	9	17.10	0.64
12. Independence Pass	125	6	17.57	0.89
13. Cottonwood Pass	125	35	17.78	1.00
Mean of all series	99		18.79	
σ	21		1.26	
Coefficient of correlation			–0.66	
Probability correlation not real			<0.02	

chemical development of pigments in wings, so its designation as a major causal factor satisfies a logical test beyond mere correlation. If one tries to show that other conditions than temperature are contributing factors, logical inconsistencies are encountered. For example, although an increase in altitude means a proportional increase in ultraviolet radiation, its designation as a major cause of variation fails to explain

TABLE II.—CORRELATION OF ALTITUDE WITH RADIUS OF RIGHT FOREWING-FEMALES

Series location	Altitude (100 ft)	N	Mean radius of series (mm)	σ
1. Starr Ranch	65	12	23.45	0.78
2. Mount Herman	70	7	22.69	1.26
3. Cheyenne Mountain	75	6	23.15	0.82
4. Almont	80	11	19.99	0.58
5. West Creek	85	30	23.80	1.29
6. Wilkerson Pass	95	11	22.01	0.82
7. Independence Pass	125	6	19.55	1.24
8. Cottonwood Pass	125	10	20.62	0.97
Mean of all series	90		21.91	
σ	24		1.65	
Coefficient of correlation			–0.61	
Probability correlation not real			<0.1	

TABLE III.—COLOR CODE USED IN MEASUREMENT OF COLOR FACTORS

Kind of factor	Factor	Color interpretation
Spot 1	3	Red-brown
Spot 1	2	Red-brown with yellow tinges
Spot 1	1	Yellow
Spot 2	2	Red-brown
Spot 1	1	Dark red-brown
Overscaling	3	Black overscaling entirely within area (3)
Overscaling	2	Black overscaling extending into area (2)
Overscaling	1	Black overscaling extending into area (1)

TABLE IV.—CORRELATION OF ALTITUDE WITH COLOR FACTORS—MALES

Series location	Altitude (100 ft)	Spot 1 factor	Spot 2 factor	Overscaling factor	Color factor
1. Starr Ranch	65	2	2	3	7
2. Cheyenne Mountain	70	3	2	3	8
3. Almont	80	1	1	3	5
4. West Creek	85	3	1	3	7
5. Rampart Range Road	95	3	1	3	7
6. Wilkerson Pass	95	3	1	3	7
7. Seven Lakes	110	2	2	3	7
8. Shrine Pass	113	1	1	2	4
9. Loveland Pass	123	1	1	2	4
10. Cottonwood Pass ('53)	125	1	1	1	3
11. Cottonwood Pass ('54)	125	1	1	2	4
12. Cottonwood Pass ('55)	125	1	1	2	4
13. Independence Pass	125	1	1	1	3
Means of all series	103	1.8	1.2	2.4	5.4
σ	22	0.93	0.42	0.77	1.8
Coefficients of correlation		–0.70	–0.61	–0.77	–0.77
Probabilities correlations not real		<0.05	<0.05	<0.05	<0.05

TABLE V.—CORRELATION OF ALTITUDE WITH COLOR FACTORS—FEMALES

Series location	Altitude (100 ft)	Spot 1 factor	Spot 2 factor	Overscaling factor	Color factor
1. Starr Ranch ('31)	65	2	2	3	7
2. Starr Ranch ('33)	65	3	2	3	8
3. Cheyenne Mountain	70	2	2	3	7
4. Mount Herman	75	3	2	3	8
5. Almont	80	1	1	3	5
6. West Creek	85	2	1	3	6
7. Wilkerson Pass	95	3	2	3	8
8. Cottonwood Pass	125	1	1	1	3
9. Independence Pass	125	1	1	1	3
Means of all series	87	1.9	1.6	2.6	6.1
σ	23.5	0.78	0.52	0.88	1.9
Coefficients of correlation		–0.50	–0.60	–0.92	–0.65
Probabilities correlations not real			<0.1	<0.05	<0.1

both the Almont sample and the observation of similar changes with increasing northerly latitude. Similarly, a consideration of the decrease in pressure as a real causal factor fails to explain these observations.

Some forms of butterflies which are presently designated as subspecies may be no more than opposite ends of a continuous species variation which corresponds to the particular environment in which the specimens matured. I hope that this study illustrates that environment can be an important factor in butterfly variation, although further studies must be undertaken to confirm whether the environmental conditions have created genetic differences between the groups of specimens or whether the variation is caused solely by the conditions under which individual specimens were subjected during their natural development.

ACKNOWLEDGMENT

I am particularly indebted to F. Martin Brown for making this study possible, for not only did he permit me to examine his extensive butterfly collection, but a number of years ago he also introduced me to the use of statistical analysis in biological investigations.

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LORQUIN'S LOCALITIES "SONORA" AND "UTAH"

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For some time Mr. Harry Clench and I have been puzzled by the type localities "UTAH (Lorquin)" and "SONORA (Lorquin)" given by the Felders for certain North American butterflies. I have come to the conclusion that Lorquin's "UTAH" has nothing to do with the present State of Utah and that his "SONORA" has equally little to do with the present Mexican state of Sonora. Currently this has become acute to me in trying to extend the work of Opler and Powell (1962) on *Apodemia mormo* beyond the area they studied. This is part of the problem to try to understand W. H. Edwards's descriptions of Riodinidae and Lycaenidae in preparation for selection of types for the names he proposed in those families.

The Felders mention or describe thirteen North America butterflies in the *Reise Novara* volume devoted to Rhopalocera (Felder & Felder, 1864–67). Two of these have little to do with the question. One is *Papilio telemonides,* a form of *marcellus* Cramer that was described from a specimen in the Royal Museum in Vienna and had been in the collection of Abbé Mazzolo. The other is the female of *Speyeria diana* Cramer that had been sent to them by Tryon Reakirt. It came from Kanawha, [West] Virginia, and doubtless had been given to Reakirt by W. H. Edwards. Edwards' (1864) description of the female appeared about a year before that of the Felders.

All of the other North American specimens named by the Felders were sent to them by Lorquin who also supplied them with many Philippine and East Indian specimens. The Lorquin North American butterflies can be arranged in three groups: those from "California," those from "Utah" and those from "Sonora."

California

Papilio albanus—a mountain form of *eurymedon* Lucas.
Lycaena zelmira—an alpine to subalpine species (= *shasta* Edw.)
Lycaena podarce—an alpine subspecies of *aquilo.*
Melitaea leanira—a lowland species west of the Sierra.
Chionobas nevadensis—a subalpine mountain species.

Utah

Pieris menapia—a widespread pine forest species.

[1] This study was made in connection with N.S.F. Grant GB 2741.

Apodemia mormo—a widespread species.
Lycaena zelmira—an alpine species (= *shasta* Edwards)

Sonora

Anthocharis cethura—a desert, or chaparral, lowland species.
Apodemia sonorensis—a chaparral species (= *virgulti* Behr).
Lycaena sonorensis—a lowland rock-loving species.
Lycaena sagittigera—a coastal species in southern California, in mountains elsewhere (= *piasus* Bdv.).

We know too little about the activities of Lorquin. There is an account in Essig (1931: 694–697) that synthesizes this. The Essig account, drawn from various sources, contains several statements that are self-refuting, especially those that refer to the termination of Lorquin's stay in California. Grinnell's account (1904) was based upon information given Grinnell by Lorquin's son. From it we see that Lorquin's collecting in California is divisible into two periods: 1850–1856 and 1861–1862. Boisduval's first paper upon the results of Lorquin's work was published in 1852, the second in 1855 and the final paper in 1869. In addition to these Boisduval published excerpts from a letter of Lorquin from California in 1856. What Boisduval knew about the man and his collecting, he summarized in the preface of the 1869 paper. This account is the one upon which I put most reliance. It is based upon many years of close association between the two men and the letters from Lorquin written in the field. Nowhere in any of the accounts do I find direct mention of Lorquin in Utah. In Boisduval's account is an interesting statement that suggests the meaning of "Sonora" when associated with butterflies that Lorquin captured. Boisduval wrote (1869: 6) ". . . il alla visiter les montagnes du nord, penetra fort avant dans l'est et se dirigea plus tard chez les Apaches, jusqu'a Los Angeles en Sonora." Thus it appears that Lorquin used the old Spanish name Sonora for southern California (and Baja California?).

California fell to the United States in settlement of the Mexican War in 1848. I have maps of the region published immediately thereafter showing the entire newly acquired land under the name "New, or Northern California." This new acquisition, "New California," extended south from the 42nd parallel. Its eastern boundary was approximately at 107° 30′ west longitude, well within the present state of Colorado, south to "Uncompahgre Mountains" where, when the stated meridian intersected the Rio Grande, it followed the west bank of the river. In two years time, a new pair of territories, Utah and New Mexico, were made from the region left over after the present boundaries of the State of California were established. Thus Lorquin's "Utah" very likely was the eastern slope of the Sierra Nevada and included no territory as far east as the present State of Utah. Attempts to establish Salt Lake City,

Utah, as the type locality for *Pieris menapia* Felder and Felder, and *Apodemia mormo* of the same authors, cannot be supported upon historical evidence. It was not until 1861 that the original Utah territory, with its ill-defined western boundary in the mountains of California, was divided into Nevada Territory and Utah Territory. In treating boundaries in this period of the development of the West it must be remembered that they were nebulous until the surveys of the 1860's and 1870's carried out the descriptions of the territories established by law years earlier. It is amusing to note that during the very early 1850's Kansas and California shared a common boundary, on paper, in western Colorado.

It seems to me that appropriate type localities for *menapia* and *mormo* must be selected from the eastern flanks of the Californian or Nevadan mountains somewhere west of the general region of Reno and Carson City, Nevada, to be in keeping with what we know of Lorquin's travels and political geography of the early 1850's. This may or may not have an effect upon the nomenclature of *menapia*. It probably will alter some concepts associated with the name *mormo*. Boisduval's *Polyommatus zeroe* (= *Lycaena mariposa* Reakirt) also was described from this area, "haute montagnes de frontieres de l'Utah. . . ."

Both Boisduval and the Felders described butterflies collected by Lorquin in "Sonora." Those named by the Felders all are found within the present limits of California and their true type localities must lie somewhere from Los Angeles southward into extreme northern Baja California. The material described from "Sonora" by Boisduval is this:

Melitaea callina: related to *elada* Hewitson.

Melitaea pola: this is close to *hoffmanni* Behr, if not the same.
Melitaea sonorae: this is *gabbii* Behr.
Ctenucha robinsonii: a synonym of *Lerina incarnata* Walker.
Phoegoptera cinnamomea: a synonym of *Aemilia roseata* Walker.

Of these, only *callina* is not yet known from southern California and northern Baja California. I know of no specimens of the *elada*-complex from the Pacific drainage area of Mexico. At first this seems to be strong evidence that Lorquin collected in that part of Mexico now called Sonora. However, Boisduval does not say that Lorquin collected the types of *callina*. In fact, only for *robinsonii* is the collector named and in that case it was Lorquin. Boisduval was in touch with collectors in Mexico and may well have received the types of *callina* from one of them.

Thus it appears that, excepting *callina*, both the Felders's and Boisduval's "Sonora" specimens may very well be considered southern Californian.

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RECENT LITERATURE

THE GENERIC NAMES OF THE BUTTERFLIES AND THEIR TYPE-SPECIES (LEPIDOPTERA: RHOPALOCERA.), by Francis Hemming. Bulletin of the British Museum (Natural History). Entomology, Supplement 9; 509 pp.; 1 August 1967. This volume treats all genera proposed from 1758 to 31 December 1963. The names are arranged alphabetically, and I estimate that about 3300 names are treated. The original description for each is cited, as is the type designation. When needed there is a brief discussion of the nomenclatorial problems involved with the name. Citations are given to any International Code of Zoological Nomenclature actions which have been taken on a name. Caution is needed in one respect: the lapse in time between the completion of the manuscript, a few days before Francis Hemming died in February, 1964, and the date of publication in 1967, requires search in those cases where Hemming proposes type species. The current volume is of course an invaluable reference book for anyone in the field of taxonomy of butterflies.—F. MARTIN BROWN, *Fountain Valley School, Colorado Springs, Colo.*

THE IMPORTANCE OF PRESERVING NATURAL HABITATS— NOW

William E. Sieker
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It was with real interest that I read the presidential address to the Twelfth Annual Meeting of the Pacific Slope Section of the Lepidopterists' Society presented by Frederick H. Rindge, entitled "The Importance of Collecting—Now" (1965, Jour. Lepid. Soc., 19: 193–195).

I share with him a deep concern for the disappearance of native habitats. However, I cannot share his pessimism concerning the possible ultimate extinction of the remaining wildlife habitats.

Most certainly overpopulation is the biggest problem facing mankind today. It is true that many wildlife habitats are being transformed into new subdivisions for our ever increasing populace or converted to farmland. It is true that pesticides and herbicides have taken a toll of insects in particular and wildlife in general.

While this is all true, there are many encouraging things being accomplished, and much more can and will be done to preserve our wildlife habitats.

The problems of overpopulation throughout the world are making a serious impact upon the governmental policies of many nations. The indiscriminate use of powerful pesticides and herbicides with persistent residues are being strictly curtailed. In Wisconsin, in particular, the State Conservation Department is now prohibiting the indiscriminate use of DDT and other persistent insecticides. Federal legislation has resulted in more strict control of the sale and application of these materials. Unfortunately, progress is slow.

In America, farming practices and agricultural research have shown that even though our population is rising it takes less acreage to produce a surplus of food. Marginal farm lands in some states are slowly and steadily being abandoned. Secondary succession will eventually transform these to forest, but it will require many years.

A great deal of native habitat remains undisturbed. Some of this land may be expensive but there is still time to preserve these areas if action is taken soon.

It has been my good fortune to be associated as legal counsel with several organizations that are dedicated to the preservation of wildlife habitat. One of these organizations, in particular, should be of great interest to members of the Lepidopterists' Society as well as to other citizens interested in the preservation of wildlife. This organization is

called "The Nature Conservancy." Legally it is a non-profit corporation organized under the laws of the District of Columbia. There are active chapters in many states. The national organization has funds which are lent without interest to the local state chapters for their efforts to purchase wildlife areas for permanent preservation. When land is purchased, title is turned over to a local educational institution. The University of Wisconsin has many branches throughout the state which have the responsibility of the management of these tracts. Almost every piece of land purchased is near a branch of the University. Title then goes to the University Regents, who preserve the area as a scientific area. To prevent the land from being used for purposes other than those originally intended for the land, a "reverter" clause is inserted in the deed conveying title which automatically "reverts" to The Nature Conservancy, or some similar organization such as the National Audubon Society.

The Wisconsin chapter is extremely active. Within the last two years we have, among other projects, purchased land by popular subscription to establish an arboretum for the University of Wisconsin at Milwaukee. This purchase is adjacent to land previously purchased by the Wisconsin Conservation Commission, completing an undisturbed area of over a thousand acres. This arboretum is presently being expanded and is almost within the metropolitan area of the City of Milwaukee.

What is especially interesting to lepidopterists is that the rare and beautiful saturnid moth, *Hyalophora columbia* (Smith) occurs here. This is one of the few places in the United States where this moth is found. Of interest to the botanist is the rare and diminutive ramshead lady slipper, *Cyprepedius arietinum* R. Br., which grows only here and one other place in the State.

Among the other projects contemplated by this organization is the purchase of a small acid bog in Door County in which *Lycaena epixanthe michigenensis* Rawson and the recently described dayflying arctiid, *Holomelina lamae* Freeman have been taken.

There are many local habitats harboring rare and unusual Lepidoptera which might be preserved through efforts by members of the Lepidopterists' Society. For example, action might be taken regarding isolated swamps in which *Euptychia mitchelli* French is found. Another worthwhile project would be the preservation of the prairie locale in Clay County, Minnesota, where *Hesperia dacotae* (Skinner) is found.

I believe it should be possible for members of our society to raise funds, with the aid of the Nature Conservancy if necessary, to protect and preserve some of the habitats of localized species of Lepidoptera, where their narrow distributional limits are in danger of engulfment by urban sprawl or other forms of human "progress."

A CORRECTED LIST OF NORTHEASTERN ARKANSAS BUTTERFLIES

My first list of Northeastern Arkansas Butterflies (J. Lep. Soc. 21:206–209) was consolidated in such a manner that it is impossible for the reader to determine which species fall into each category of abundance.

Rhopalocera of Northeastern Arkansas

Abundant to Common Species:

Amblyscirtes vialis (Edwards)
Atalopedes campestris (Boisduval)
Polites themistocles (Latreille)
Pholisora catullus (Fabricius)
Erynnis juvenalis (Fabricius)
Thorybes pylades (Scudder)
Battus philenor (Linnaeus)
Papilio glaucus Linnaeus
Graphium marcellus (Cramer)
Nathalis iole Boisduval
Colias eurytheme Boisduval
Calycopis cecrops (Fabricius)
Satyrium falacer (Godart)
Libytheana bachmanii (Kirtland)
Limenitis archippus (Cramer)
Junonia coenia (Hubner)
Phyciodes tharos (Drury)
Danaus plexippus (Linnaeus)
Atrytone delaware (Edwards)
Wallengrenia otho (Smith)
Hylephila phyleus (Drury)
Pyrgus communis (Grote)
Thorybes bathyllus (Smith)
Achalarus lyciades (Geyer)
Papilio polyxenes asterius Stoll
Papilio troilus Linnaeus
Pieris protodice Boisd. & LeConte
Pieris rapae (Linneaus)
Eurema lisa Boisd. & LeConte
Strymon melinus Hubner
Everes comyntas (Godart)
Limenitis arthemis astyanax (Fabricius)
Vanessa atalanta (Linnaeus)
Polygonia interrogationis (Fabricius)
Euptoieta claudia (Cramer)
Euptychia cymela (Cramer)

Uncommon to Scarce Species:

Panoquina ocola (Edwards)
Amblyscirtes aenus linda Freeman
Euphyes vestris (Boisduval)
Pompeius verna (Edwards)
Nastra lherminier (Latreille)
Erynnis persius (Scudder)
Staphylus mazans hayhurstii (Edwards)
Epargyreus clarus (Cramer)
Colias cesonia (Stoll)
Eurema nicippe (Cramer)
Chrysophanus titus mopsus (Hubner)
Celastrina argiolus (Linnaeus)
Asterocampa celtis (Boisd. & LeConte)
Vanessa cardui (Linnaeus)
Polygonia comma (Harris)
Agraulis vanillae (Linnaeus)
Euptychia gemma (Hubner)
Lerodea eufala (Edwards)
Amblyscirtes celia belli Freeman
Poanes zabulon (Boisd. & LeConte)
Lerema accius (Smith)
Erynnis brizo (Boisd. & LeConte)
Erynnis horatius (Scudder & Burgess)
Autochton cellus (Boisd. & LeConte)
Colias philodice Godart
Phoebis sennae eubule (Linnaeus)
Anthocaris midea Hubner
Satyrium edwardsii (Grote & Robinson)
Anaea andria Scudder
Vanessa virginiensis (Drury)
Nymphalis antiopa (Linnaeus)
Melitaea nycteis (Doubleday)
Euptychia hermes sosybius (Fabricius)

Rare or Casual Species:

Calpodes ethlius (Stoll)
Hesperia meskei (Edwards)
Thorybes confusis Bell
Papilio cresphontes Cramer
Polites coras (Cramer)
Erynnis zarucco (Lucas)
Battus polydamas (Linnaeus)
Mitoura gryneus (Hubner)

(Continued on page 278)

Rare or Casual Species (*continued*):

Incisalia henrici (Grote & Robinson)
Lycaena phleas americana Harris
Asterocampa clyton (Boisd. & LeConte)
Phyciodes phaon (Edwards)
Lycaena thoe Guerin-Meneville
Hemiargus isola (Reakirt)
Polygonia progne (Cramer)
Chlosyne gorgone carlotta (Reakirt)

Sight Record:

Phoebis philea (Johansson)

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POLYTHRIX OCTOMACULATA, NOT *PROCERUS*, IN TEXAS (HESPERIIDAE)

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I recorded *Urbanus auginus auginulus* (Godman and Salvin) for the United States based on a pair of specimens that I collected at Pharr, Texas, during March, 1945. Since that time careful study by various lepidopterists has resulted in the correct placement of the name *auginulus*. We now know that *auginulus* is a synomym of *Polythrix procerus* (Ploetz), which occurs rather rarely in Mexico and has not as yet been found in the United States. The confused status of *octomaculata*, *auginulus*, and *procerus* at the time the Texas record was published resulted in the incorrect identification of the specimens involved. In the process of making a careful study of the Hesperiidae of Mexico I became aware of this error after having collected a number of specimens of various species of *Polythrix*. The two specimens that I collected in Texas in 1945 actually are a pair of *Polythrix octomaculata* (Sepp).

At this time I would like to remove the name *Polythrix procerus* (Ploetz) from the list of United States species of Hesperiidae and in its place insert the name *Polythrix octomaculata* (Sepp), which previously has not been recorded for this country.

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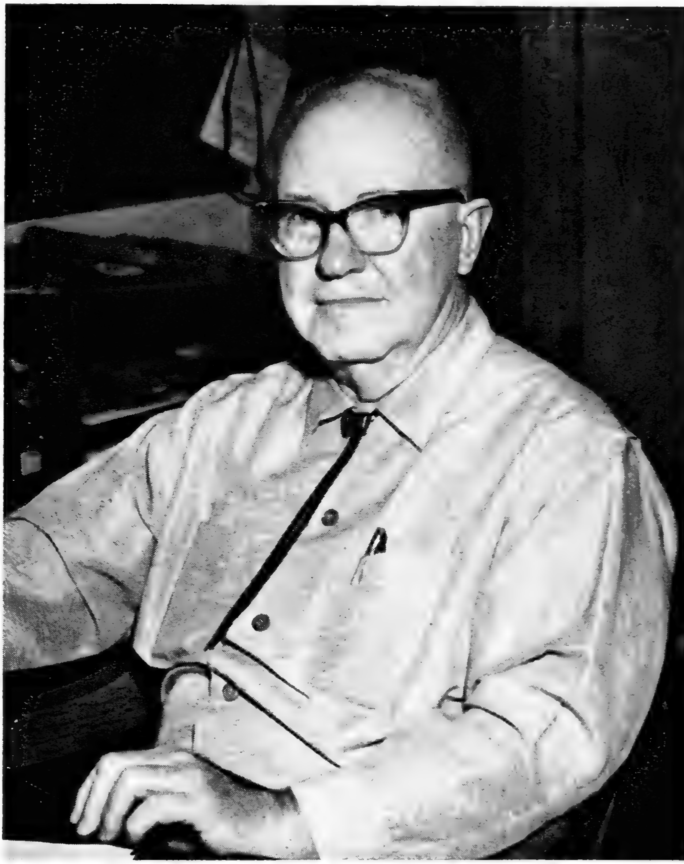
[1] I would like to express my thanks to the National Science Foundation for Research Grant GB-4122 which is making this study of the Hesperiidae of Mexico possible.



WILLIAM CARMICHAEL COOK (1895–1967)

William Carmichael Cook, a well-known entomologist for nearly a half century, died of a heart attack at Walla Walla, Washington, February 16, 1967. He had suffered from heart trouble for some years, even before his retirement from the United States Department of Agriculture in 1962 after 32 years of service. Dr. Cook was born in Syracuse, New York, October 2, 1895, obtaining his early education there, including a few years at Syracuse University. In order to major in entomology, he transferred to Cornell University, where he received his B. S. degree in 1917. After a short period in the Army, he became an assistant to the State Entomologist of Minnesota in 1919. He earned his M. S. degree in 1920 and his Ph. D. degree in 1922 from the University of Minnesota. During this time he became very much interested

in the ecology of insects and the effect of climate on their distribution. After his appointment in 1921 as assistant at the Montana Experiment Station at Bozeman, he carried on research on climate and insects with the pale western cutworm, a serious grain pest of the western prairie states. It was during this period that Dr. Cook became interested in the Lepidoptera with special emphasis on the Noctuidae. He was a charter member of The Lepidopterists' Society. He also began to build up his own collection of Noctuids.

In 1930, Dr. Cook took over the research and control of the beet leafhopper in California in the Entomology Research Division of the U. S. Department of Agriculture with headquarters at Modesto. These studies resulted in several publications of great worth to the industry and to growers of sugar beets and tomatoes.

In 1943, Dr. Cook was transferred to Walla Walla, Washington, to help with the control of wireworms damaging crops under irrigation in the Pacific Northwest. Here again his enthusiasm for entomological research resulted in a fine publication on the effects of several soil fumigants on wireworms. He was later assigned to the problem of controlling pea aphids, and he soon discovered that they overwintered on alfalfa in areas some distance from the pea fields. By controlling the aphids on alfalfa in early spring by burning or spraying before migration took place, the infestations in the pea fields were greatly reduced.

Dr. Cook is survived by his wife, Muriel Amidon, of Minneapolis, whom he married in 1920, a daughter, Mrs. John A. Barton of Seattle, and two grandchildren. He was a member of the American Association for the Advancement of Science, Entomological Society of America, Ecological Society of America, The Lepidopterists' Society and Sigma Xi. "Bill" Cook was a dedicated entomologist, ever ready to help and inspire those associated with him. With a good knowledge of statistics as applied to biological research, together with a facility for clear writing, his many publications will stand the test of time.

M. C. Lane, Tacoma, Wash.
E. J. Newcomer, Yakima, Wash.

A COLONY OF *CALEPHELIS VIRGINIENSIS* (RIODINIDAE) AT HOUSTON, TEXAS

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Although *Calephelis virginiensis* (Guerin-Meneville) is listed in most publications as probably occurring in Texas, its presence there has heretofore been known by only two verified records. Both are specimens in the U. S. N. M. collection; one is labelled "Texas," and the other, "Blackjack Springs, Texas." Thorough collecting has failed to turn up the species in the latter area. Recently I discovered a colony in a grassy pine flat near Delmar Stadium in northeast Houston. From 1 September to 16 November, 1966, the colony yielded thirty-nine individuals as follows:

1 Sept., 1♂. 6 Sept., 1♂. 8 Sept., 1♂, 2♀♀. 20 Sept., 1♀. 24 Sept., 1♂. 25 Sept., 1♂. 9 Oct., 1♂. 30 Oct., 5♂♂, 3♀♀. 11 Nov., 12♂♂, 2♀♀. 8 Nov., 1♂, 1♀. 12 Nov., 1♂. 13 Nov., 1♂. 14 Nov., 2♂♂, 1♀. 16 Nov., 1♀.

Although numerous females were taken, and a wide variety of plants offered as possible oviposition substrata, the only eggs obtained were laid by one individual on its container. These produced thirteen larvae which were each offered a different foodplant; all refused to eat and died. Close observation of females in the field produced similarly negative results. The writer was on occasion assisted in these attempts by Roy O. Kendall, an authority on the life histories of Texas Rhopalocera. The area containing the colony is being rapidly developed into an industrial park, and it is possible that before a spring brood can appear time will have run out for the colony.

RECENT LITERATURE

GUIDE TO THE GEOMETRIDAE OF CANADA (LEPIDOPTERA). I. SUBFAMILY STERRHINAE. by McGuffin, W. C. *Mem. ent. Soc. Canada*, no. 50: 67 pp., 102 figs. 1967. The first in a series of manuals planned to cover some 450 Canadian species of Geometridae includes diagnoses of all stages of the family and keys to subfamilies and to the 7 Canadian genera and 24 Canadian species of Sterrhinae. Line drawings illustrate adults, genitalia, and characters of the early stages; adults are shown in 62 small but clear color photographs. Ranges and known food plants are given. Aside from a few unsatisfactory photographs of early stages this is an admirable handbook.—P. F. BELLINGER, *San Fernando Valley State College, Northridge, Calif.*

Wyatt, Colin W., "Additions to the Rhopalocera of Afghanistan with descriptions of new species and subspecies." *Jour. Lepid. Soc.*, 15: 1–18, 3 pls., 1 fig. 1961. Describes as new *Papilio alexanor hazarajatica* (Joshanak Valley, S. of Band-i-Amir, W. Koh-i-Baba Mts., 9,500 feet); *Hypermnestra helios ariana* (Bamian, N. of Koh-i-Baba Mts., 8,300 feet); *Parnassius tianshanicus shiva* (Kars Pass, Shiva Mts., N. Badaghshan, 11,000 feet); *Zegris fausti lucullus* (Band-i-Amir, Hazarajat, N. of Koh-i-Baba Mts., 9,500–10,500 feet); *Synchloe callidice hazara* (Band-i-Amir, 11,400 feet); *Melitaea shandura apsara* (above Kars Pass, 12,500–14,000 feet), *M. kuchi* (Band-i-Amir, 11,500 feet); *Boloria hegemone houri* (Bala Quran, Anjuman Valley, Hindu Kush Mts., 14,300 feet); *Pararge eversmanni shiva* (Shiva Mts., 9,000 feet); *Karanasa pamira kotandari* (Kotandar Pass, Paghman Mts., Kabul, 11,000–12,500 feet), *K. p. twomeyi* (Bala Quran, 11,000 feet); *Paralasa asura* (Bala Quran, 13,000 feet), *P. shakti* (Bala Quran, 14,000 feet); *Hyponephele shivacola* (Shiva Mts., 9,000 feet); *Lyela amirica* (Ban-i-Amir, 9,500–11,000 feet); *Lycaena aeolus* (Bala Quran, 14,300 feet); *Ramburia antonia shivaensis* (Shiva Mts., 6,500–8,000 feet); *Thymelicus lineola kushana* (Shiva Mts., 8,500 feet).

Wyatt, Colin W., "Eine neue *Parnassius*-Rasse aus Nordamerika" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 144–146, 1 pl. 1961. Describes as new *P. smintheus rubina* (Liberty Peak, Ruby Mts., 3,120 m., Nevada). [P. B.]

Wyatt, Colin W., "Further additions to the Rhopalocera of Afghanistan." *Jour. Lepid. Soc.*, 18: 78, 2 figs. 1964.

Yano, Kôji, "New or little known species of the genus *Platyptilia* Hübner from Japan (Lepidoptera, Pterophoridae)." *Mushi*, 34: 137–141, 3 figs. 1960. Describes as new *P. sinuosa* (Masatumi, Yamanasha Pref.). Records *P. rhododactyla*, new to Japan; describes & figures genitalia. [P. B.]

Yano, Kôji, "A new genus of Pterophoridae from Japan (Lepidoptera)." *Mushi*, 35: 87–90, 2 figs. 1961. Describes as new *TOMOTILUS* (monobasic), *T. saitoi* (Sakai, Osaka Pref., Honshu; reared from *Dunbaria villosa*). [P. B.]

Zelný, Ján, "Zur Kenntnis von *Pieris bryoniae* O. aus den Karpaten" [in German]. *Zeitschr. wiener ent. Ges.*, 46: 19–22, 58–64, 100–110, 2 pls., 1 map. 1961. Study of distribution, geographical & local variation, and race formation of *P. bryoniae* in Carpathians. [P. B.]

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(New names in **boldface**)

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